Department of Energy
Review Committee Report

on the

Construction Project Review

of the

WASTE TREATMENT AND IMMOBILIZATION PLANT PROJECT

at the Office of River Protection at Hanford

August 2011

EXECUTIVE SUMMARY

A Department of Energy (DOE) Construction Project Review (CPR) of the Waste Treatment and Immobilization Plant (WTP) project was conducted on August 22-25, 2011 at the request of the Deputy Secretary of Energy. The purpose of this review was to assess the cost, schedule, and technical progress against the approved Performance Baseline. Specific review areas were Technical Systems; Startup and Commissioning; Environment, Safety, Health, and Quality Assurance (ESH&Q); Cost, Schedule, and Risk; and Management. This is the sixth CPR of the project. The last full CPR was held in November 2010, and a mini-review, focused on cost and schedule, was held in March 2011. The majority of the previous recommendations have been closed.

The WTP is the Department's largest capital asset line-item construction project, with an approved budget of $12.26 billion. Its mission is to treat and vitrify approximately 56 million gallons of radioactive chemical waste stored in underground storage tanks at the DOE Hanford Site near Richland, Washington. The project, under the DOE Office of River Protection (ORP), is an Engineer, Procure, Construct, and Commission (EPCC) cost-plus-award-fee contract with Bechtel National, Inc. (BNI). The project is approximately 60 percent complete.

Summary

While substantial advances have been made, the Committee found that because cost growth continues to outpace savings opportunities and resolution of some technical issues has been delayed, it is increasingly unlikely that the project can be completed within the approved budget of $12.26 billion. A potential $100 million decrease to the FY 2012 Department's funding request would further exacerbate the project's cost and schedule challenges. A refined approach to treating a small fraction of High Level Waste is endorsed by the Committee as an opportunity to mitigate additional cost growth.

Technical

Integration between the Tank Farms (TF) and WTP, as well as planning for sequential commissioning, is proceeding. Significant progress has been achieved on many technical issues, but overall progress is slower than expected. The highest priority technical issues are associated with the performance of Pulse Jet Mixer (PJM) vessels, Hydrogen in Piping and Ancillary Vessels (HPAV), safety systems design, and developing a commissioning and startup strategy. Progress has been made in developing an overall plan for performing the Large-Scale Integrated

Tests (LSIT) to better understand the behavior of PJMs, but has not yet been completed. The closure of the Quantitative Risk Assessment (QRA) issue related to HPAV requires incorporation of the QRA results into the Pretreatment Facility safety basis. More attention needs to be given to operability aspects of the WTP. An alternate technical approach to licensing and startup of the WTP presents a significant opportunity to arrest continued PJM cost growth by bounding testing plans and adding operational flexibility to the treatment campaign. This approach is strongly endorsed for stakeholder coordination and subsequent implementation.

Commissioning and Startup

Overall progress is appropriate for this stage of the project; however, contractor Cognizant System Engineering resources need to be staffed to support commencement of system turnover and testing starting in 2012. The baseline has been updated to reflect the multiple ORR approach, and specifications for commissioning simulants have been developed. Training processes are well designed and provide an opportunity for a cultural safety message to the employees. BNI has created an Integration, Startup and Completions (ISC) Organization since the last CPR. It will be important for the Department to integrate the different prime contractor's contracts, philosophies, and financial incentives, along with customers from multiple parts of DOE. This integration is complex, but absolutely critical to the Hanford waste stabilization mission.

ESH&Q

The ESH&Q program is effectively managed. Although deficiencies with out-of-date technical databases supporting the Preliminary Documented Safety Analysis (PDSA) are a new concern, the maturity of other ES&H and Quality programs continues to be commensurate with expectations for this stage of the project. The project team has appropriately identified permits needed to support construction and start-up efforts. Environmental permit conditions need to be incorporated into BNI operational procedures. To avoid potential delays, an extent of condition review of the PDSA is recommended as well as a complete evaluation of the staffing necessary to support nuclear safety analyses and environmental permitting.

Cost, Schedule, and Risk

With the continuation of unresolved technical issues, identification of new risks, and realization of existing risks exceeding opportunities, successful completion of the project within the approved project cost of $12.26B is a formidable challenge. Assuming the current approved

funding profile, the committee has identified a potential cost overrun of approximately $800-$900 million based on the currently identified risks and an extrapolation of risks being realized at the historic project rate. This can be partially offset by a $350 million phased Critical Decision (CD-4) opportunity, presently in the change control process. Some significant threats exist that have not yet been fully identified or sufficiently understood to be incorporated into the cost estimate. The Committee is concerned that deferral of scheduled work poses an increased risk to the project schedule and that the risk program and Estimate at Completion (EAC) processes are underestimating the forecasted EAC. Reducing the baseline funding profile will adversely affect cost and schedule performance.

The alternate technical approach for treating the minority fraction of waste through operational efficiencies and lessons learned during initial operations runs is supported by the full committee and may provide a key vehicle for stabilizing cost growth. The Committee supports the One System 2020 Vision approach; however, it's near term costs, funding requirements, and overall benefits should be analyzed, presented to, and approved by the Office of Environmental Management (EM) at DOE Headquarters.

Management

The Federal and BNI onsite management teams are highly qualified, motivated, and effective in responding to the myriad of WTP technical, construction, and stakeholder coordination challenges. While a strong, comprehensive effort has been initiated to integrate the WTP and Tank Farm activities, and is fully supported by WTP and TF leadership, it is not clear whether funding will support these plans. EM HQ needs to assign a strong portfolio program manager with authority and accountability for both WTP and TF. Among other responsibilities, this manager would make decisions on implementing the One System 2020 Vision concept, obtain stakeholder support for the new technical approach for licensing and start-up, and balance budget priorities between WTP, Tank Farms, and other EM programs.

A mini-review focused on cost and schedule performance is recommended for January 2012, and the next full CPR should be scheduled in the spring of 2012.

CONTENTS

Appendices

ACRONYMS

AE .....Acquisition Executive
AJHA .....Assisted Job Hazard Analysis
ASME .....American Society of Mechanical Engineers
BAC .....Budget at Completion
BCP .....Baseline Change Proposal
BNI.....Bechtel National, Inc.
BOF.....Balance of Facilities
CAM .....Control Account Manager
Cs .....Cesium
CD .....Critical Decision
CFD.....Computational Fluid Dynamics
CLIN .....Contract Line Item Number
CPR.....Construction Project Review
CY .....Calendar Year
DCD .....Design Control Database
DF .....Decontamination Factor
DNFSB.....Defense Nuclear Facilities Safety Board
DOE .....Department of Energy
DOORS .....Dynamic Object-Oriented Requirements System
DQO.....Data Quality Objectives
DSA.....Documented Safety Analysis
DTP.....Demonstration Test Plan
DV.....Design Verification
DWP.....Dangerous Waste Permit
E&NS .....Environmental and Nuclear Safety
EAC.....Estimate at Completion
Ecology .....Washington State Department of Ecology
EM.....DOE Office of Environmental Management
EMAB .....Environmental Management Advisory Board
EPC .....Engineering, Procure, and Construct
EPCC.....Engineering, Procure, Construct, and Commission
ESH&Q .....Environment, Safety, Health, and Quality Assurance
ETC .....Estimate to Complete
ETF .....Effluent Treatment Facility
FPD .....Federal Project Director

FU .....Forecast Update
FY .....Fiscal Year
HazOp .....Hazards and Operability
HIHTL.....Hose-in-Hose Transfer Line
HLW .....High-Level Waste Facility
HPAV.....Hydrogen in Piping and Ancillary Vessels
HQ.....Headquarters
ICD.....Interface Control Document
IHLW .....Immobilized High-Level Waste
IPO .....Initial Plant Operations
IRT .....Independent Review Team
ISC .....Integration, Startup, and Completions
ISM .....Integrated Safety Management
IX .....Ion Exchange
LAB.....Analytical Laboratory
LAW .....Low-Activity Waste Facility
LBL .....Laboratory, Balance of Facilities, and Low-Activity Waste Facility
LOAM.....Low-Order Accumulation Model
LSIT .....Large-Scale Integrated Testing
MR .....Management Reserve
NETL .....National Energy Technology Laboratory
NNV.....Non-Newtonian Vessel
OMB .....Office of Management and Budget
OR.....Operations Research
ORP.....DOE Office of River Protection
ORR .....Operational Readiness Review
P&ID.....Piping and Instrumentation Diagram
PCT .....Product Consistency Test
PDSA .....Preliminary Documented Safety Analysis
PJM .....Pulse Jet Mixer
PMB .....Performance Measurement Baseline
PRA.....Probabilistic Risk Assessment
PT.....Pretreatment Facility
PUREX .....Plutonium URanium Extraction (Facility)
PVV.....Process Vessel Vent
QRA .....Quantitative Risk Assessment
RCRA.....Resource Conservation and Recovery Act

REDOX.....Reduction-Oxidation
RVM .....Requirements Verification Matrix
SC.....Safety Class
SCIX .....Small Column Ion Exchange
S/CI .....Suspect/Counterfeit Item
SPI.....Schedule Performance Index
Sr .....Srontium
SRS .....Savannah River Site
SS .....Safety Significant *or* Shared Services
SSCs.....Structures, Systems, and Components
SSO .....Safety System Oversight
STARRT .....Safety Task Analysis Risk Reduction Talk
TAC.....Test Acceptance Criteria
Tc .....Technetium
TF .....Tank Farms
TOC.....Tank Operations Contractor
TPA .....Tri-Party Agreement
TPC .....Total Project Cost
TRC.....Total Recordable Case
TRU.....Transuranic
TSR .....Technical Safety Requirement
TWS .....Tank Waste Subcommittee
USQ.....Unreviewed Safety Question
V&V.....Verification and validation
VAC .....Variance at Completion
WAC .....Waste Acceptance Criteria
WAI.....Waste Acceptance Impacting
WIR.....Waste Incidental to Reprocessing
WRPS.....Washington River Protection Solutions, LLC
WTP .....Waste Treatment and Immobilization Plant at Hanford

1. INTRODUCTION

The U.S. Department of Energy (DOE) Waste Treatment and Immobilization Plant (WTP) is the cornerstone of the mission to clean up 56 million gallons of hazardous and radioactive waste contained in 177 underground storage tanks located at the Hanford Site in eastern Washington State. This nuclear waste is the result of more than four decades of reactor operations and plutonium production for national defense. The infrastructure that supports storage of this waste is aging, and continued storage of the waste poses a threat to the environment. This is DOE's largest and most complex environmental cleanup project.

1.1 Background

The WTP (Figure 1) is a $12.26 billion construction program composed of five separate subprojects, each of which provides a key function in treating and immobilizing waste at the Hanford Site. Bechtel National, Inc. (BNI), along with its prime subcontractor, URS-Washington Division, is responsible for designing, constructing, and commissioning the WTP.

Nuclear waste materials from the Hanford Site Tank Farms will be retrieved and pumped via transfer lines to the WTP for processing. The WTP will receive and process the waste by separating it into low-activity waste (LAW) and high-level waste (HLW) feed streams.

Figure 1. Aerial view of WTP

The waste feed will be separated into soluble and insoluble fractions. Radionuclides will be removed from the soluble fraction to the maximum extent technically and economically practical. The LAW materials will then be immobilized via vitrification for onsite disposal at the Hanford Site. The high-activity radionuclides separated from the soluble and insoluble fractions

will become the HLW feed and will be immobilized via vitrification for ultimate disposal in a national repository.

1.2 WTP Facility Descriptions

The five subprojects of the WTP are: 1) Pretreatment (PT) Facility, 2) HLW Facility, 3) LAW Facility, 4) Analytical Laboratory (LAB), and 5) Balance of Facilities (BOF). Each facility fulfills a key function in treating and immobilizing waste, as described below.

Pretreatment Facility

The PT Facility (Figure 2) is the largest and most complex of the five subprojects. Pretreatment is the first step in treating the waste stream at Hanford. The Tank Farms Operating Contractor (TOC) transfers waste from the storage tanks to the PT Facility. Transferred waste may be either LAW or HLW to be pretreated to separate out LAW prior to vitrification of each resulting stream.

The waste streams will be processed as follows: LAW feeds are pretreated to remove transuranic (TRU) solids using ultrafiltration (as necessary) and then the LAW liquid stream is processed through ion exchange (IX) columns to remove cesium.

Figure 2. The Pretreatment Facility

HLW feeds requiring pretreatment, including separation of aluminum and other LAW components, will be concentrated with respect to solids content using ultrafiltration. The resulting concentrated solids slurry will be caustically leached, washed, oxidatively leached, washed, and blended with cesium (Cs) concentrate from the IX, and strontium (Sr)/TRU solids before being transferred to the HLW Facility.

Feeds containing organic chemicals can cause the Sr and some TRU waste to remain in solution. This waste will undergo a process to precipitate the Sr and TRU waste before filtration. The filtration step then separates the Sr/TRU solids, manganese oxide solids, and entrained solids from the LAW stream. The Sr/TRU precipitate is washed and stored before high-level waste vitrification.

After filtration, the LAW undergoes the IX process to remove Cs. The Cs from this process is concentrated by evaporation and then blended with pretreated HLW solids before transfer to the HLW Facility vitrification process. The last step in the PT Facility is to concentrate the treated LAW liquid by evaporation before transferring the waste to the LAW Facility vitrification process.

The PT Facility also contains a process-vessel ventilation system, an offgas treatment system, and a stack. The remaining liquids are either recycled back into the facility or sent to the Hanford Site Liquid Effluent Retention Facility (LERF)/200 Area Effluent Treatment Facility (ETF).

High-Level Waste Vitrification Facility

The HLW Facility (Figure 3) is the second largest subproject. It receives pretreated high-level waste feed from the PT Facility. Treated slurry and the LAW intermediate waste products—separated Sr/TRU and Cs—make up the feed to the HLW Facility.

Figure 3. The HLW Facility

The HLW Facility vitrification system consists of two ceramic melters fed by independent feed and blending vessel trains, a dedicated offgas treatment system for each melter, and a common secondary effluent collection system.

The HLW feed concentrate is transferred from the PT Facility to the HLW Facility vitrification building. Batches of concentrate are transferred to one of the two melter feed preparation vessels. The feed concentrate is blended with glass-forming materials and then mixed to ensure a uniform mixture. The melter feed slurry is transferred to the melter feed vessel, where it can be fed to a dedicated HLW Facility melter. A canister receipt system supplies canisters to the melter pouring systems that fill the canisters with vitrified HLW and then provides the canister containing immobilized high-level waste (IHLW) to a canister decontamination and export system.

The HLW Facility melters are each designed to produce three metric tons of IHLW per day. The melter feed slurry is introduced at the top of the melter and forms a cold cap on the surface of the melt pool. Water and volatile components evaporate or decompose and are drawn off through the offgas system. Nonvolatile components react to form oxides, which become part of the molten glass. An airlift system inside the melter pours the molten glass into stainless-steel canisters. The filled canister is inspected, and the glass within is sampled and sealed. The sealed canister is transferred to the interim storage area for storage before being transferred to a national geological repository.

Low-Activity Waste Vitrification Facility

The LAW Facility (Figure 4) is the third largest subproject. The LAW Facility consists of two melter systems operated in parallel. Each melter system has a set of feed preparation vessels, a large capacity ceramic melter, and an offgas treatment system. The facility also has a secondary offgas system shared by the two melter systems. Pretreated LAW feeds are transferred to receipt vessels inside the LAW Facility vitrification building. This solution is fed into the melter feed preparation vessels, where glass formers are added and blended into a slurry that is sent to the melter feed vessels and ultimately to the LAW Facility melters.

Figure 4. The LAW Facility

The LAW Facility melters are each designed to produce 15 metric tons of Immobilized Low-Activity Waste (ILAW) per day. The feed enters the melter from the top and forms a cold cap above the melt pool. Volatile components in the feed are evaporated or decomposed, then drawn off through the melter offgas system. Nonvolatile components react to form oxides or other compounds dissolved in the glass matrix. Bubblers agitate the mixture to increase the glass production rate. An airlift system pours the glass from the melter into stainless-steel containers. After the container is filled, it is sealed with a lid and transported to the on-site disposal facility.

Analytical Laboratory

The principal functions of the LAB (Figure 5) are to support process control and perform waste qualification testing, environmental analysis, and limited-technology testing. The LAB has the ability to receive, prepare, analyze, and record data for samples having low to high levels of radioactivity.

Figure 5. The Analytical Laboratory (LAB)

Samples are taken from the Tank Farms, PT, HLW, and LAW Facilities. Samples are also taken from the BOF. Tank Farm samples are manually transferred to a laboratory outside of the WTP complex. PT and HLW samples are automatically transferred to the hot cell receipt area. LAW samples are pneumatically transferred to the radiological laboratory receipt cell. From these receipt cells, the samples are transported to the hot cells and radiological laboratories for preparation, division into subsamples, and analysis. Samples requiring preparation in the hot cells, followed by analysis in the radiochemical laboratories, are transferred manually from the hot cells to the radiochemical laboratories.

Before, during, and after analysis completion for each sample, data are recorded in the Laboratory Information Management System (LIMS). After each sample has been analyzed, the residual solid waste will be sent to the hot cell waste collection cell. Liquid waste will be sent to the liquid waste collection system and will later be pumped back to the PT Facility.

Balance of Facilities

The BOF subproject (Figure 6) is composed of 20 support facilities and 100 systems across the 65-acre WTP construction site. It provides the interconnecting utilities and other infrastructure support to the PT Facility, HLW Facility, LAW Facility, and LAB. While not directly involved with the processing or vitrification of radiological material, these facilities and systems are essential to the operation of the plant.

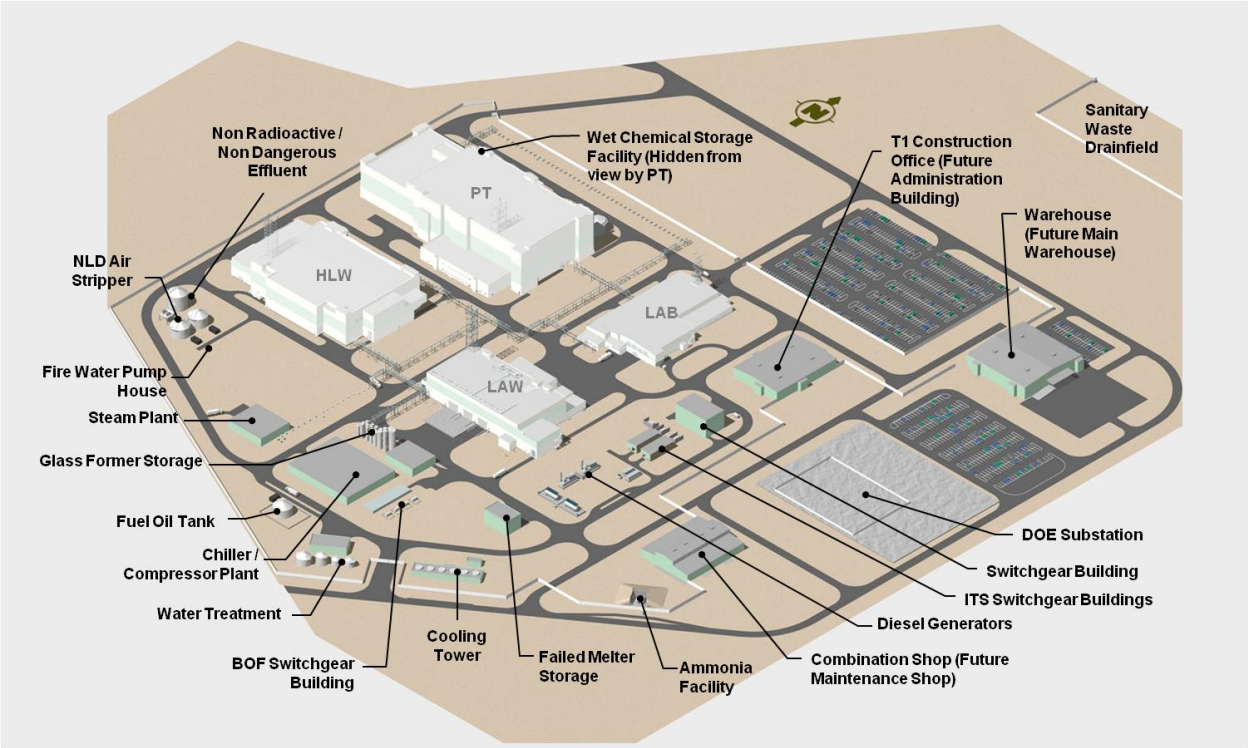


Figure 6. Balance of Facilities (BOF)

The BOF infrastructure and facilities include the following functional groups: electrical power, steam, water, air, process support, waste facilities, and miscellaneous support buildings. The electrical power group consists of three switchgear buildings and two emergency generator facilities. The steam group consists of a steam plant and a fuel oil facility. The water group consists of cooling towers, water treatment facility, chiller/compressor facility, and the firewater facility. The air group is made up of the compressors. The process support group consists of the glass former storage facility, wet chemical storage facility, and the anhydrous ammonia storage facility. The waste facilities group consists of the failed melter storage facility, and the nonradioactive effluent facility. The miscellaneous support buildings group includes the administration building, simulator facility, and warehouse; as well as roads, lighting, potable water, sanitary waste, and stormwater systems.

1.3 Membership of the Committee

The Charge to the Committee (Appendix A) was issued in a memorandum dated July 29, 2011, from Daniel B. Poneman, Deputy Secretary of Energy. The Review Committee was formed with members (Appendix B) selected for their independence from the project, as well as for their technical and management expertise. The Committee was organized into five subcommittees, each assigned to evaluate a particular aspect of the project corresponding to the subcommittee members' areas of expertise. The Committee was chaired by Robert B. Raines, Associate Administrator for Acquisition and Project Management, National Nuclear Security Administration, and co-chaired by Lowell V. Ely, Director, Office of Project Assistance and Assurance, Office of Environmental Management.

1.4 The Review Process

WTP project personnel supplied information to the Committee several weeks in advance of, and during, the onsite review. The onsite portion of the review was held at the BNI Project Office North Annex August 22-25, 2011. The review agenda (Appendix C) and lines of inquiry for the review were developed collaboratively by the Committee and the Federal and BNI project teams.

The first day of the review consisted of a plenary session with overview presentations by principals of the Federal and BNI project teams, followed by a site tour for Committee members. The Committee then convened in Executive Session at the end of the day to discuss initial impressions. The second day continued with presentations, as well as breakout sessions and individual interviews held to more deeply explore issues of interest. This was followed by the Committee reconvening in Executive Session in the late afternoon to discuss and evaluate the material presented by the project. The third day continued with breakout sessions and discussions with project experts. In the afternoon subcommittees discussed and drafted material for the closeout briefing and for the report. Preliminary results were then presented to, and discussed by, the full committee during a dry run of the closeout briefing. The closeout briefing material was finalized in the morning of the fourth day and then presented to senior management from DOE Headquarters, Office of River Protection (ORP), and BNI.

The final results, contained in this report, have been individually authored and collectively reviewed by Committee members.

2. TECHNICAL SYSTEMS

The charge for the Technical Subcommittee was:

- Is the project team making timely, substantive progress on resolving the outstanding technical issues to complete the design and focus on construction and start up activities?
- Are WTP technical issues being resolved in coordination with tank farm activities to allow for an integrated tank waste system approach to processing waste?
- Are there any unresolved issues associated with technology, design, or nuclear safety?

The answer to the first two of these three questions is a qualified yes. The answer to the third question is yes. Significant progress has been achieved on some technical issues but overall progress is slower than expected. For example, an integrated strategy involving large-scale integrated testing (LSIT) and computational fluid dynamics (CFD) modeling to resolve design issues for the pulse jet mixer (PJM) vessels has not yet been completed, although this strategy was earlier planned to be completed in January 2011. Further, a test plan identifying the objectives and testing approach (i.e., test conditions and simulants) to meet each objective for LSIT and the approach to verification of CFD modeling against test results at different scales is needed.

Substantial progress has been achieved on resolution of the issues concerning the use of quantitative risk assessment (QRA) as part of the design to mitigate the hazard from potential hydrogen events in piping and ancillary vessels (HPAV), but additional work remains. Similarly, progress has been made on other technical issues as discussed in the sections that follow, but substantial work remains to bring closure to these issues.

Integrated approaches by the WTP Project and the Tank Farms to resolve technical issues have progressed. However, further progress is challenged by potential funding as well as contractual and organizational constraints. A DOE portfolio manager is needed to fully integrate budgets and priorities between the WTP Project and the Tank Farms. With current strained resources and separate organizational responsibilities and objectives for the WTP Project and the Tank Farms, each entity necessarily focuses on its individual priorities and drivers with less attention to the overarching objectives of the integrated system. For example, the WTP Project

places highest priority on completion of construction and commissioning of the WTP facilities, independent of whether or not adequate feed to maintain WTP throughput will be available. The Tank Farms highest priority is meeting near-term regulatory milestones (from either the Federal Facilities Agreement or the Consent Decree), while available resources constrain upgrading and implementing the tank farm systems necessary to provide feed for WTP.

There remain several major unresolved issues associated with technology, design and nuclear safety. Most of these issues are receiving significant attention and are tracked by "cut sheets" that provide monthly updates to senior DOE and contractor management. As discussed below, the highest priority issues are associated with the performance of PJM vessels, HPAV, safety systems design, and developing a commissioning and start-up strategy.

While past CPRs have focused largely on issues associated with Pretreatment (PT), this CPR put additional emphasis on the resolution of technical issues and design completion of other WTP facilities including LAW and HLW.

2.1 Findings

Responses to November 2010 CPR Technical Recommendations

The November 2010 CPR technical recommendations and their respective current status are as follows:

Recommendation 1 – Prior to January 2011, WTP should develop an integrated plan and DOE-ORP should identify funding for large-scale integrated testing (LSIT) that address resolution of remaining PJM mixing risks.

Status: Partially complete; progressing slower than anticipated. See follow-up CPR Recommendations 1 and 2 at the end of this chapter. While funding has been identified to execute the LSIT program, an integrated plan that pulls together all elements of resolving PJM technical and safety issues has not been fully developed. A number of the components exist, e.g., Project Execution Plan for LSIT and an approach for Integrated PJM Vessel Design and Control Strategy, but these are not coordinated with the effort for verification and validation of the CFD model that is the basis for the bulk of PJM design.

Recommendation 2 – Prior to January 2011, DOE-EM should develop draft interim guidance regarding use of quantitative risk assessment (QRA) in HPAV design and WTP should

develop a quantitative evaluation of the impact of active HPAV controls on WTP safety, worker exposure, operability, and throughput.

Status: Complete. See follow-up CPR Recommendation 3 at the end of this chapter. In December 2010 and January 2011, the Department developed a draft Probabilistic Risk Assessment (PRA) Standard[1]. Development of this standard included DOE representatives as well as laboratory and contractor subject matter experts, a number of who had been engaged in review of the WTP QRA approach and were sensitive to WTP QRA development issues. In February 2011 the EM Principal Deputy Assistant Secretary issued the draft PRA Standard with associated guidance to its field managers asking for considerations of piloting the standard. Because the QRA effort was well underway and had already undergone an independent technical review, the WTP project stated they did not want the standard and guidance imposed on the project as a requirement. Instead, DOE and contractor personnel are working to crosswalk the QRA effort against the EM guidance and the draft PRA Standard.

Concerning the recommendation to develop a quantitative evaluation of the impact of active HPAV controls, the project deferred to an earlier assessment of these impacts. Although some members of the CPR team were interested in more quantification of benefits, the team concluded that the ability to further quantify these benefits was limited. During the current CPR review, the team agreed that the project response was acceptable.

Recommendation 3 – By March 2011, WTP should develop a detailed action plan to improve the fidelity of the operational research (OR) model and to produce updated availability and throughput estimates that incorporates current WTP design.

Status: Partially complete. See follow-up CPR Recommendation 4 at the end of this chapter. Progress has been made on including additional data and uncertainties in the OR model. Some areas have been addressed, but responses to comments from external reviews have not been completed.

Recommendation 4 – By March 2011, WTP should develop a detailed action plan to accelerate reconciliation of the design and the functional requirements of safety systems.

Status: Complete. A plan was developed to identify actions to address design needs for these safety systems; status is being tracked on a bi-weekly basis.

[1] For the purposes described here, the QRA is a specific application of PRA.

Recommendation 5 [joint with the Management Subcommittee] - Within three months, carry out a detailed independent review of WTP and Tank Farms options for sequenced hot commissioning and transition to waste feed and operation of WTP facilities.

Status: Complete. Review implemented by EMAB Tank Waste Subcommittee. However, the review scope was limited to implementation of the One System Plan, and the review team did not have time or scope to examine broader options.

Design Completion and Licensing Strategy

The WTP Project is put at risk by the expectation that at design completion the WTP must be demonstrated to be able to treat all of the waste. Currently, combined uncertainties concerning the full range of waste characteristics, operational strategies, and the absence of an agreed upon validated design basis for PJM vessels is making demonstration of adequate performance and design confirmation of PJM vessels dependent on open-ended large-scale integrated testing and performance simulation with CFD modeling.

Resolution of the issues associated with PJM vessels is a critical path item for completion of design and construction of the Pretreatment facility (PT). Furthermore, the current commissioning and operational strategy requires PT to be operational to provide waste meeting waste acceptance criteria (WAC) for subsequent treatment in the Low Activity Waste (LAW) Vitrification and High Level Waste (HLW) Vitrification facilities.

PJM Vessels

The previous CPR report noted that a hold had been placed on welding the vessel heads for three of the five non-Newtonian vessels, pending completion of the Low Order Accumulation Model (LOAM) confirmation testing. Since that time the project has determined that the LOAM model would not be used for design-related activities. Additionally, DOE agreed to allow welding of heads on all five non-Newtonian vessels but has replaced the original hold with an "identical hold" on installation of the vessels until technical issues are resolved as part of the large-scale integrated testing (LSIT) program, design validation, and other activities.

A number of documents exist that are steps towards resolving remaining technical issues with the PJM vessels. Key documents include: *Integrated PJM Design and Control Strategy*, Rev. 1 (draft); the *Large Scale Integrated Test Project Execution Plan*, Rev. 0; *V&V Plan for FLUENT Following the ASME V&V20-2009 Standard;* 24590-WTP-RPT-ENG-11-01,

Determination that Non-Newtonian Vessels Can be Evaluated Using Newtonian Techniques; and, the LSIT Working Schedule.

The strategy for resolving PJM vessel technical issues is being addressed by two separate efforts: (i) verification and validation (V&V) of CFD models so that CFD simulations can be used for PJM vessel design verification, and (ii) LSIT to validate the scale-up design basis, demonstrate vessel performance, and confirm the CFD model. Progress has been made in developing an overall plan for performing LSIT of PJMs to facilitate the closure of remaining technical issues, but has not yet been completed.

While the LSIT and CFD efforts address many of the same technical issues, the WTP contractor's internal reporting structure is different and separate for the LSIT and the CFD V&V efforts. In addition, DOE-WTP has retained an independent review group through the National Energy Technology Laboratory (NETL) to assist with reviewing CFD V&V efforts, but has not engaged this group to review the LSIT planning that might impact the CFD evaluation and the PJM vessel scale-up basis.

A key assumption to using the CFD model as the design basis for the five non-Newtonian vessels is a determination that Newtonian fluid techniques can be used. This assumption is documented in the technical report *Determination that Non-Newtonian Vessels Can be Evaluated Using Newtonian Techniques* listed above. This report has been reviewed by both Pacific Northwest National Laboratory and the Savannah River National Laboratory. DOE has requested that testing, outside of LSIT, be conducted to confirm this assumption related to mixing zones of influence. If successful, this path forward would allow a verified and validated Newtonian CFD to be used as the design basis for the non-Newtonian vessels and would preclude the need for V&V of a non-Newtonian CFD model.

In December 2010, the Defense Nuclear Facilities Safety Board (DNFSB) issued Recommendation 2010-2, *Pulse Jet Mixing at the Waste Treatment and Immobilization Plant.* The project has drafted an implementation plan to address the seven specific sub-recommendations and is working with DNFSB staff to ensure the LSIT program will address DNFSB concerns.

Hydrogen in Piping and Ancillary Vessels

Resolution of the QRA issue continues to progress with involvement of DOE, the HPAV Independent Review Team (IRT), and the DNFSB. Specifically, progress has been made in the resolution of IRT findings and recommendations, implementation of software quality assurance, and finalization of the tools to perform the HPAV/QRA evaluation.

Actions to resolve findings and address recommendations made by the HPAV IRT were documented in an Implementation and Closure Plan. During the previous CPR, all of the actions in the Implementation and Closure Plan were scheduled for completion and review by the IRT by March 24, 2011. At the time of the current CPR on-site review, these actions had not yet been completed, and the schedule was to complete these actions by September 2011, followed by a briefing to the DNFSB in October 2011. This schedule has now slipped. Production runs of HPAV/QRA analyses and evaluations would begin after these activities occur.

The final closure of the HPAV/QRA issue requires incorporation of the QRA results into the Pretreatment Facility safety basis, i.e., the Preliminary Documented Safety Analysis (PDSA) or Documented Safety Analysis (DSA). In a memo dated 8/25/2010, the EM Office of Safety and Security Program (EM-20) stated that DOE-ORP should "clearly define and document the role of the QRA relative to STD-3009, and provide this information to EM for review." During the November 2010 CPR, it was noted that the lack of a DOE policy regarding the use of QRA in HPAV design, and hence how the QRA would be treated in the facility PDSA/DSA, could cause delay and complication in the resolution of the HPAV/QRA issue. A recommendation was made for DOE to develop expeditiously draft interim guidance regarding the use of QRA.

The WTP Federal Project Director provided the project position in a memo dated 12/09/2010, noting that "the relationship of QRA to DOE-STD-3009 is the interface between the safety analysis and design to ensure applicable assumptions are protected and, when necessary, captured as Technical Safety Requirements (TSRs) to ensure that facility operations are conducted within the approved safety basis." The memo concluded that "the use and role of QRA for the WTP are within the existing DOE rule, policy, and order system requirements." A review of this project position by DOE-EM's Technical Authority Board concluded that it complied with DOE-STD-3009 and noted that DOE must "ensure that assumptions attendant to the WTP QRA are preserved and protected in the DSA, with appropriate TSR controls applied." The project was subsequently directed by DOE-EM to establish the processes and procedures needed to ensure that assumptions were preserved and protected in the safety basis, as it is developed in conformance with the Technical Authority Board conclusion. In addition, DOE-

HSS (Office of Health, Safety and Security) has now issued a draft standard, "Development and Use of Probabilistic Risk Assessments in Department of Energy Nuclear Safety Applications," for use and comment by Program Secretarial Officers.

Safety Systems

The November 2010 CPR Recommendation 4 was to develop a detailed action plan to accelerate reconciliation of the design and the functional requirements of safety systems. The November CPR had noted several conditions where safety systems did not yet meet all functional requirements and posed significant design challenges given the state of the design and construction. Further, some of these conditions had the potential to significantly impact cost and schedule. It was also observed that although BNI appeared to have mature and robust processes to identify and track these safety-system design discrepancies, the discrepancies were not being quickly resolved.

Fourteen safety system conditions requiring resolution have now been documented. The potential consequences of design changes to resolve these conditions vary. Three conditions are judged to represent low potential consequences (less than $1M and no schedule impact), seven conditions are judged to represent medium potential consequences (less than $10M without critical schedule impact), and four conditions are judged to represent high potential consequences (greater than $10M and/or critical schedule impact).

A separate action plan has been developed for each of these identified safety system conditions. The action plans identify a responsible lead from both the engineering organization and the nuclear safety organization, specific actions, and due dates. The status of these action plans are to be reviewed at least monthly.

Design Margin

According to the information provided for review, there are no major systems at or near their design margins. In general, design margins are internalized in Engineering Calculations and are protected based on how underlying assumptions are managed. There is a comprehensive process in place to manage the assumptions related to Engineering Calculations; however, design margins themselves are not routinely evaluated.

Completion of Systems Descriptions

System descriptions appear at Level 6 in the WTP Design Document Hierarchy and are necessary for the detailed designs, Level 7, for each system. The system descriptions consist of Part 1, functions and requirements; Part 2, design; and Part 3, demonstrations/tests, conditions, and criteria for the test program for that system.

The WTP CPR reviews of August 2009, May 2010, and November 2010 have expressed a desire for a more complete set of system design documents to facilitate their understanding of the complexities of the WTP design, especially at the system level. The detailed chemical processing HazOps analysis, based on final design, has not been possible for many processing systems due to priorities and resources. It is very desirable to recognize significant HazOps issues as early as possible to avoid subsequent rework. Given the nature of the chemical hazards in the facility, various structures, systems and components (SSCs) could be identified that require either design modifications or operating constraints as a result of these detailed HazOps analyses.

WTP Operability

Failure to resolve WTP operability issues represents a potential significant risk to the WTP project cost and schedule. If not properly mitigated, these issues also present a further risk to WTP mission completion milestones and to safe and efficient plant operations.

The principal tool for managing operability risk in any process facility, and specifically in WTP, is a detailed understanding of the plant's operating systems and how they interact during normal and transient conditions. However, DOE is presently not in a position to have a comprehensive understanding of the operability risk for WTP as it relates to the balance of EPC, commissioning, or subsequent operations.

The current update of the WTP Operations Research Model Action Plan, presented during this CPR review, continues to reflect a number of assumed nominal operating conditions rather than the broader range of normal and transient conditions that would likely be expected over the WTP mission. Consideration of the range of normal and transient conditions in a "best estimate" model run that accounts for interactions between individual systems would likely result in a reduced prediction of plant total integrated availability. The prediction, currently projected based on nominal operating conditions, is only slightly above the contract requirement of 70 percent. One potential outcome of a more comprehensive evaluation of WTP operability is the

need for rework to remediate observed operational deficiencies, which otherwise may not become apparent until during commissioning or after radioactive operations are initiated.

Three important steps towards an improved understanding of WTP operability have not yet been taken: (i) DOE has not yet provided, or required the Contractor to provide, a resource base of Cognizant System Engineers who would be the dedicated experts in systems performance; (ii) the Contractor has not yet made sufficient progress in completing detailed Part 2 System Descriptions for non-safety systems; and (iii) DOE has not directed the WTP contractor to address issues from external reviews (e.g., CLIN 3.2) that address WTP operability. The CLIN 3.2 report identified a number of operability risks that have not yet been responded to or incorporated into RPP-42219 Functional Areas for Review during Commissioning. A second such CLIN 3.2 report, now being written, is addressing additional operability issues and will likely identify additional risks.

One System Plan

The recommendations made during the November 2010 WTP CPR and most recent DOE Environmental Management Advisory Board Tank Waste Subcommittee (EM-TWS) review are in the process of being addressed by DOE-ORP and its contractors. These recommendations include the need for an independent review, building the business case for the plan, and need for an integrated approach for WTP startup and commissioning. Plans and schedules have been updated including the proposed path forward to integrating the Tank Farms and WTP commissioning, consideration of project risks, and early LAW operations based on the One System Plan. A request for proposal for revisions to both BNI and WRPS contracts, which would realign them under the One System Plan, has been prepared, DOE approvals for issuance obtained, and the contractors have received direction to respond. Because this is considered procurement sensitive, it was not available for CPR review.

Systems Verification and Validation (V&V)

Processes are in place to implement design verification and validation (V&V) and develop corresponding V&V matrices for WTP systems. Although the design verification mechanisms tend to be focused at the component level with systems-level processes in development, the process is comprehensive and appears consistent among disciplines from the information and examples provided for review.

Waste Acceptance Criteria

The waste acceptance criteria (WAC) for the Pretreatment (PT) Facility are documented in BNI Contract Specification 7 for the LAW facility and Specification 8 for the HLW facility and will be enforced using the waste feed Interface Control Document (ICD-19), which is being revised. The WAC for waste transfers from PT to the LAW or HLW Facilities are under development and have not yet been documented. Product control in the LAW and HLW facilities will be based on their respective Compliance Plans. The overall approach to uncertainty management to assure WTP process efficiency and product acceptance is being defined.

Tc Capture and Recycle

Based on current design assumptions, 20.2% of the technetium (Tc) entering WTP would end up in the LAW Facility vitrified product; 77.1% of the entering Tc must be treated in the Supplemental LAW Facility, which is yet to be selected for design and construction. The decontamination factor (DF) used for the HLW and LAW glass is based on laboratory-scale melter runs and appears reasonable. Steady state model runs using the TFCOUP6 feed vector[2] and dynamic analysis using the System Plan 3 (May 2008) feed vectors have been used to evaluate the ability to maximize HLW and LAW glass production. The use of this feed vector in a reference plan is consistent with WTP contract requirements, but the overall System Plan has evolved considerably. Information related to potential impacts of Tc capture and recycle design assumptions on individual subsystems was not provided for review. In addition, information on the potential for accumulation of other constituents as part of recycle, which may have an adverse impact on waste processing performance was not available. In general, the ability to effectively treat the majority of the Tc-99 in the Hanford tanks over the full lifetime of WTP operations depends on the management of the discharge from the LAW submerged bed scrubber and supplemental LAW treatment technology that has yet to be selected. It should be noted, however, that recycle within WTP or to the tank farms may occur during early WTP operations.

[2] This feed vector is the assumed blending, composition and sequence of feed provided from the tank farms to WTP.

2.2 Comments

Design Completion and Licensing Strategy

Currently, difficult to process wastes in a small number of tanks are driving safety issues and associated performance requirements for PJM vessels in the PT facility. A preliminary review of tank waste inventories, based on currently available characterization data, indicates that problematic conditions exist in only a few of the 177 tanks. Large plutonium (Pu) oxide particles are most likely only in two tanks (Z Plant wastes in Tanks SY-102 and TX-118) and there is greater than 20 kg Pu (Pu-239 through Pu-242) in only 9 tanks (PUREX and REDOX sludges) although large particles, if they exist in other tanks, could accumulate if mixing is not adequate or vessels are not adequately cleared. A detailed review of this and additional information is being completed and current findings indicate that up to eight tanks potentially received significant quantities (>750 g) of dense large particles of Pu oxide or metal (AN-101 ~ 1.6 kg, C-102 ~ 0.77 kg, S-108 ~ 1 kg, SY-102 ~ 12.65 kg, TX- 105 ~ 2.37 kg, TX-109 ~ 4.14 kg, TX-118 ~ 2.72 kg, and 244-TX ~ 1 kg).

Setting aside waste from some or all of the tanks containing large Pu oxide particles ("restricted waste") may reduce the criticality issues raised from potential settling and retention of Pu particles in WTP PJM vessels and thereby reduce the LSIT requirements for demonstrating vessel performance.

Wastes in two tanks (Tanks AN-102 and AN-107) have projected high flammable gas production rates (i.e., hydrogen from thermolysis) because of high organic content. In addition, there are wastes in approximately 23 tanks that are anticipated to be difficult to process because of unique chemical characteristics rather than criticality or hydrogen-generation safety considerations. With some overlap, these include high phosphate wastes (4 tanks), high sulfate wastes (4 tanks), high chromium and boehmite wastes (9 tanks), high fluoride wastes (2 tanks) and high silicate wastes (6 tanks).

Targeting problematic wastes for later treatment after WTP operations are mature would in the meantime allow for significant and timely risk reduction of the waste currently stored in single-shell tanks. WTP could process less problematic wastes for more than a decade, while improving the understanding and performance envelope for PT. Even if performance cannot be adequately demonstrated during this time for some of the problematic wastes, a number of

practical solutions could be pursued, including waste conditioning in the tank farms (e.g., grinding, blending, chemical treatment) or bypassing PT with direct feed to HLW vitrification.

In addition, requiring commissioning of PT prior to HLW commissioning and operation creates a risk of cascading delays if technical or non-technical issues delay the completion of PT. PT is the most complex of the WTP facilities and is at greatest risk for delays during commissioning. Requiring all high-level waste to pass through PT to feed HLW puts HLW operations at risk if PT is delayed in startup or experiences prolonged shutdowns during the planned 35 years of operation. Having an option available to feed waste directly to the HLW facility could mitigate this risk. The benefits of delivering waste directly to HLW need to be balanced against the potential for producing more HLW canisters with higher attendant costs for their disposal.

Taking a more graded approach to WTP licensing and operations does not eliminate the need for LSIT, verification of the computational fluid dynamics model, or having an integrated strategy for processing wastes within the constraints of the performance of PJM vessels in the PT facility. Rather, the graded approach shifts the focus of LSIT and vessel design confirmation from needing to demonstrate effective mixing for all wastes to be processed to (i) demonstrating effective mixing for a large fraction of the HLW tank wastes, (ii) defining the performance envelope for the PJM vessels and delineating the wastes that can be treated within that performance envelope, and (iii) developing a strategy for processing wastes that are outside of the accepted performance envelope.

PJM Vessels

Although both CFD and LSIT efforts are in progress to support PJM vessel design and verification, these efforts appear to be stove-piped and their coordination does not appear to be at a management level that will assure the best opportunity for success. The project manager of the LSIT effort reports via a program manager to the BNI Project Manager, whereas the CFD effort is under a separate manager reporting to the Engineering Manager.

One example of the lack of integration is the draft implementation plan for DNFSB Recommendation 2010-2 that includes a milestone to compare and document CFD predictions to LSIT results. Although the specific V&V effort is outside the LSIT scope, the LSIT working schedule includes neither this milestone nor specific ties from the LSIT program necessary to perform this comparison, such as use of the results from the LSIT 14-foot diameter vessel tests as part of the CFD assessment. Additionally, neither the design verification strategy nor the role

of the confirmatory testing requested by DOE for zone of influence as related to Newtonian methods for the non-Newtonian vessels has been clearly defined.

Hydrogen in Piping and Ancillary Vessels

Although progress has been made on this issue, there has been significant delay in completing the actions resulting from the HPAV IRT assessment. The issuance of a DOE-ORP position on implementing the QRA and DOE's draft standard for development and use of probabilistic risk assessments were positive steps toward resolving some of the DNFSB concerns with the HPAV/QRA evaluations.

The incorporation of assumptions and results from the HPAV/QRA evaluations into the PDSA/DSA would be a significant part of resolving the HPAV/QRA issue. However, there has not been significant effort towards planning or preparing for this activity. This represents a significant potential vulnerability in the successful implementation of the HPAV/QRA approach. Without more definitive work in this area, it will not be possible to reach agreement with the DNFSB on the implementation of HPAV/QRA at WTP, especially in relation to the PDSA/DSA.

Safety Systems

None of the safety system conditions discussed during the November 2010 CPR have been resolved. However, individual action plans have now been developed that are aimed at increasing attention and accelerating the resolution of these safety system conditions. Progress towards the execution of these action plans should be evaluated at the next CPR.

Design Margin

The process for protecting design margins via assumption management for a large, complex system like the WTP is considered a standard practice; however, a more transparent and routine consideration of design margins might improve efficiency in the design process and greater transparency in the component and system design limits.

Completion of Systems Descriptions

The Technical Subcommittee was under the impression (from the November 2010 CPR) that the Part 2 system descriptions were needed for final design verification, but now understands that there are sets of detailed layouts (e.g., piping and instrumentation diagrams, P&IDs) for

equipment, control, and sensing that are independently verified but not rolled up into the Part 2 system descriptions.

Although the Part 2 system descriptions seem to be the only place where each system design is described in detail, BNI does not use these Part 2 descriptions for formal activities such as HazOps analyses, system engineering reviews, design verifications, development of instrumentation strategies, etc. Many of these activities are conducted by personnel outside the design group, and it will be difficult for such reviewers to easily understand the system and whether or how all the functional requirements in the Basis of Design are met by the detailed system designs.

In particular, the contractor will need to soon appoint cognizant system engineers to oversee commissioning of each system. For those engineers to understand the system design, a Part 2 system description would appear to be essential. Certainly it has proven very difficult to review plant technical details during the short CPR periods without the Part 2 descriptions given the complexity and hierarchy of documentation for each system.

WTP Operability

Sufficient attention has not been given to the operability aspects of WTP. Considering the present advanced state of project completion, now is an appropriate time to increase that attention.

Evaluation of overall WTP availability includes contributions from design margins and operability margin of individual structures, systems, and components (SSCs) and a further contribution from unknown events. However, defining the operability margin entails an appraisal of the expected range of normal and transient operations, which in turn relies on a comprehensive understanding of pertinent systems performance. Unknown events would also lead to unexpected interactions between operating systems, which in turn would involve the same level of understanding of system descriptions and control strategy. Since systems performance and the control strategy have not been completely described or assessed, it is not apparent what confidence levels should be ascribed to design margin and integrated availability projections. Since there are no confidence levels, it is not clear that the projected overall WTP availability of 71.8% versus a contract specification of 70% is significantly different.

The primary approach to efficiently conducting the WTP project has been to develop progressive physical elevations within each segmented facility area and SSCs within each of

those elevations. This approach would seem to place integrated systems design and performance (which may extend across multiple physical elevations and areas) as a subordinate consideration, even though WTP is fundamentally a large integrated processing facility. Integrated systems performance, however, is the fundamental focus of operability.

Resources outside the WTP project have begun to evaluate operability and the CPR Technical Subcommittee believes that timely, careful and substantive responses to the findings and recommendations from these external reviews are important. Greater attention to the systems aspects of WTP is also a pre-requisite to understanding operability issues. Consequently, the Technical Subcommittee's findings in this area are also a driver behind the recommendations to more timely complete and utilize the Part 2 System Descriptions (which describe the integrated purpose and intention of each system). The issue of operability also relates to considerations being addressed by other CPR Subcommittees, namely: Commissioning and Startup (hiring Cognizant System Engineers) and Cost and Schedule (allocation of post CD-4 risk). Operability also relates to technical recommendations 1 and 5 made below in this chapter.

Other technical issues described in this CPR review address the potential for alternate WTP operations strategies, the early initiation of LAW, BOF and Lab (LBL) operations, and sequencing of commissioning for individual WTP facilities. It would appear that these strategic and/or related programmatic decisions would be facilitated by a more comprehensive understanding of WTP operational flexibility, based on detailed systems performance descriptions and supported by a Cognizant Systems Engineering resource base.

One System Plan

The One System Plan developed by WTP and the Tank Farms Operating Contractor describes an approach now in process to create an integrated contractor organization within WTP for managing the ongoing work on WTP in response to DOE's 2020 Vision. 2020 Vision is a proposed approach to execute an early start of LAW as supported by LAB and BOF and requiring interim waste processing and feed from the tank farms. This proposal is still under discussion. 2020 Vision would allow for LAW treatment 15 months prior to the current baseline schedule. The proposed plan would require changes to Tank Farm processing capabilities to filter solids and separate cesium from the LAW feed (required to meet LAW feed requirements; e.g., for a contact handling facility) and then directly feed the LAW Facility until the Pretreatment (PT) Facility becomes available. Secondary wastes from the LAW Facility would be returned to the Tank Farm until PT is commissioned and the Effluent Treatment Facility (ETF) has been upgraded.

The November 2010 CPR recommended that DOE-HQ should carry out, within three months, a detailed independent review of WTP and Tank Farms options for sequenced hot commissioning and transition to waste feed and operation of the WTP facilities. A subsequent detailed review of the One System Plan was carried out by the Environmental Management Advisory Board (EMAB) Tank Waste Subcommittee (TWS). This review did not explore options beyond the proposed One System Plan and WTP responses to the resultant EMAB recommendations were under development at the time of this CPR.

The EMAB review recommended proceeding with a proposed management realignment and integration between the Tank Farms (TF) and WTP to facilitate sequential commissioning and early LAW operation, defining a compelling business case, focusing on only those elements needed for early LAW operations, making earliest practical LAW and HLW processing the highest priority, and setting up a fast-track permitting program. Information was provided during the CPR that showed progress on a number of these areas including integration between TF and WTP and planning for sequential commissioning. However, neither a compelling business case for the One System Plan nor plans for feeding HLW independent of PT were provided for review. Further details of the One System Plan need to be developed before it is possible to judge its viability, especially in the context of evolving schedule and budget constraints.

The proposed One System Plan offers a number of potential regulatory benefits. Most importantly, its successful implementation increases the likelihood that DOE will successfully achieve the two key waste treatment regulatory milestones mandated by the 2010 Washington State Consent Decree[3]. These milestones call for "Hot Start of Waste Treatment Plant" by 12/31/2019[4] and "initial plant operations" (IPO) by 12/31/2022[5]. The milestones are a principal mandate of the Consent Decree. Thus, a program to increase the likelihood of successful compliance with these milestones has great potential value to DOE. As outlined elsewhere in this report, overall WTP project risks are reduced by accelerating LAW operations and using a phased commissioning approach.

[3] *Consent Decree No. 08-5085-FVS*, U.S. District Court Eastern District of Washington, State of Washington v. Steven Chu, Secretary of Energy, U.S. Dept. of Energy, October, 2010.

[4] "Hot Start of Waste Treatment Plant" means the initiation of simultaneous operation of the Pretreatment (PT) Facility, High-level Waste (HLW) Facility and Low-activity Waste (LAW) Facility (including as needed the operations of the Analytical Laboratory (LAB) and the Balance of Facilities) treating Hanford tank wastes and producing a waste glass product. This is likely obvious, but we are assuming that sequential versus simultaneous operations of the same facilities would satisfy this Consent Decree.

[5] "Initial plant operations" under this Decree is defined as, over a rolling period of at least 3 months leading to the milestone date, operating the WTP to produce high-level waste glass at an average rate of at least 4.2 Metric Tons of Glass (MTG)/day, and low-activity waste glass at an average rate of at least 21 MTG/day.

Systems Verification and Validation (V&V)

Processes have been put in place for design verification and validation (V&V) implementation and V&V matrix development for WTP structures, systems, and components (SSCs). Design verification (DV) is an additional review apart and independent from checks and other reviews that are part of the usual and customary design process. DV is performed to determine the adequacy of design for components that are safety class (SC), safety significant (SS), and Waste Acceptance Impacting (WAI). DV methods include one or more of the following: design reviews, qualification testing, and alternate calculations. During a design review, items are captured using a Design Verification Matrix organized by engineering discipline. Safety components are evaluated using a base set of 21 questions (including those from NQA-1) in addition to those contained in BNI Corporate procedures, when appropriate. Design verification of each SSC, documented in a Design Verification Report, is completed before relying on the component function or installation becomes irreversible. Examples were provided that demonstrated the comprehensive nature of the design verification process for SSCs.

The WTP design verification process focuses on components; whereas the systems-level evaluation is being taken via the development of Requirements Verification Matrices (RVMs) for specific safety systems. This approach to compliance with system-level requirements was based on a business decision. RVMs will provide the linkage between the higher-level criteria contained in the Systems Descriptions (still under development for many systems) and startup and commissioning activities. RVMs are planned for the approximately 40 systems containing safety components.

Waste Acceptance Criteria

Because the WTP was designed and constructed as a single plant, the WAC for waste transfers from PT to the LAW or HLW Facilities for treatment will not be documented in standalone documents. The LAW/HLW WAC that ultimately will be documented in process control strategy documents are being revised and/or defined based on glass content requirements, flowsheet analysis, and safety basis constraints including hydrogen generation rate, and shielding/dose limits for each facility.

Product control in the LAW and HLW facilities will be based on the respective ILAW Product Compliance Plan and IHLW Waste Form Compliance Plan. Because a number of the

critical process constraints (e.g., those related to melt viscosity) and product limits (e.g., Product Consistency Test (PCT B), Li, and Na leach values for the waste glass) cannot be measured directly, control of the melter feed and melt composition to a high confidence becomes necessary. The ILAW Product Compliance Plan and IHLW Waste Form Compliance Plan have been developed. However, the implications of the necessary composition control as it propagates back through the WTP process to the Tank Farm (and including the potential impacts of inventory, sampling, and processing uncertainties) appears to need additional evaluation. The development of the overall approach to managing the significant uncertainties to assure efficient operations and product quality for the WTP lifecycle has been initiated.

Tc Capture and Recycle

Because the large majority (77.1%) of Tc is accumulated in the discharge from the LAW submerged bed scrubber and assumed to be treated via Supplemental LAW technology or separate management of the submerged bed scrubber discharge, decisions beyond the WTP project potentially will have significant impact on WTP design and operations. If a supplemental treatment technology other than vitrification is selected, then a Supplemental Treatment Technologies Report must be submitted by October 31, 2014 and the treatment technology selected by April 20, 2015 according to the current Tri-Party Agreement (TPA). These milestones indicate that decisions for Supplemental LAW treatment must be made in the FY2011 to early FY2012 timeframe to accommodate necessary regulatory and design/build considerations. Alternative management strategies for the submerged bed scrubber discharge are being considered which would reduce the Tc treatment requirements for Supplemental LAW or during process recycle within WTP.

Studies are in progress to further evaluate the retention of Tc during melter operations and as a result of process recycle. The decontamination factor (DF) currently used for the HLW and LAW glass processing evaluations is based on laboratory-scale DM100[6] melter runs performed at the Vitreous State Laboratory. Despite the small melt surface, previous results indicate that results from the DM100 are reasonable to use to develop the design assumptions for the much larger HLW and LAW melters that will be used. Steady state model runs using TFCOUP6 feed vectors and dynamic analysis using the System Plan 3 (May 2008) feed vectors have been used to evaluate the ability to maximize HLW and LAW glass production based on the assumed melter DF. However, additional work appears to be needed to evaluate the impacts of uncertainties in not only Tc capture in the WTP melters, but also in the inventory and

[6] The DM100-WV has a melt surface of 12×14 inches for a melt surface area of 0.108 m^2. The nominal depth of the melt pool is approximately 19 inches, and the typical glass inventory is 115-120 kg.

distribution of Tc in the Hanford tanks and constituent phases, as well as the fate of Tc during processing and pretreatment. Additional consideration is also needed concerning the potential for constituents other than Tc to accumulate during recycle and adversely impact system waste processing performance.

Various studies are also in progress to better target the treatment of difficult-to-process wastes such as those with high concentrations of Tc within the highly variable characteristics of the Hanford tank wastes. Most of these studies are beyond the WTP project scope.

2.3 Recommendations

Recommendation 1 – By October 2011, the WTP Project (ORP & BNI) should refine the commissioning and initial licensing strategy to include:

- Validation by DOE (HQ and ORP/WTP) that a sufficient fraction of the overall amount of waste (e.g., greater than 80 percent) can be processed at WTP based on the plant configuration at project completion (CD-4b).

- Pursuit by the WTP Project (DOE & BNI) and ORP (tank farms) of an integrated strategy whereby the performance of the design is consistent with the waste acceptance criteria and nuclear safety constraints at the time of initial operations.

- Identification by BNI of the wastes that may necessitate criticality or other controls beyond the initially validated PT system performance, and development of controls that restrict processing of the identified wastes.

- Identification by ORP of options for future processing of the restricted wastes by WTP as part of the overall waste processing strategy.

Recommendation 1a – By December 2011, ORP should evaluate the potential benefits and risks of hot commissioning HLW prior to PT.

Recommendation 1b – By December 2011, ORP and the WTP Project should ensure that the joint interface between Tank Farms and WTP (ICD-19) includes the physical capability (connection point) to supply feed directly to the HLW facility, bypassing PT.

Recommendation 2 – By October 2011, BNI should develop a plan to integrate all efforts that support design verification of the PJM vessels and assign a technical lead to the resulting integrated project. The plan should include evaluation of the fidelity and uncertainty of the CFD design basis against the LSIT results including those from the 14-foot vessel, and the uncertainty resulting from the Newtonian analysis assumptions for the assessment of non-Newtonian vessels.

Recommendation 3 – By October 2011, BNI needs to define and initiate implementation of a process for incorporating the HPAV QRA assumptions and results into the PDSA/DSA, and ORP needs to develop a proactive strategy for achieving DNFSB acceptance of the strategy for incorporating the HPAV/QRA results in the PDSA/DSA.

Recommendation 4 – By December 2011, ORP should address issues raised by external operability reviews of the WTP facility (e.g., WRPS CLIN 3.2). Issues raised by future operability reviews should be addressed within six months. This recommendation is meant to focus attention on technical issues concerning operability of the as-built WTP facility.

Recommendation 5 – By October 2011, BNI should establish an accelerated schedule for improving and completing System Descriptions to enable their effective use in current and near-term activities, including hazard analysis/HazOp reviews, cognizant system engineer reviews, instrumentation and control strategy, and commissioning procedures.

3. STARTUP AND COMMISSIONING

In answer to the charge questions, overall progress for startup and commissioning is appropriate for this stage of the project. However, contractor Cognizant System Engineering resources need to be staffed (budgeted and hired) to support commencement of system turnover and testing in 2012.

Elements of an operations organization are visible at the WTP, on both the DOE and BNI sides. Several activities completed since the November 2010 CPR have contributed to progress in preparation for the startup and commissioning phase and to keeping pace with the planned schedule. Since the last review, the multiple Operational Readiness Review (ORR) approach has been incorporated into the project baseline, a forecast update 4 (FU-4) re-plan has been completed, a completions/integration organization established, and the One System (2020 Vision) proposal submitted to DOE.

Other activities completed since the last review included issuing the Commissioning Training Implementation Matrix, conducting condition assessments of the Balance of Facilities in preparation for turnover, and aligning the plant operations organization. In addition, WTP hosted the second Waste Prequalification workshop with the Tank Farms Operating Contractor, Savannah River National Laboratory, and WTP. WTP also began implementation of plant equipment obsolescence monitoring.

While overall progress has been good, the lack of system engineers and the slow development of the large-scale integrated test (LSIT) have further increased startup and commissioning risk since the last review. Commissioning risks have increased because of the uncertainty due to staffing issues in the ability to conduct operability evaluations, to develop adequate safety basis controls and to prepare operations procedures in a timely manner to support commissioning and subsequent operational readiness reviews.

With regard to the previous recommendations from the November review, DOE has completed the recommendation for filling the vacancy for the DOE WTP Startup and Commissioning Manager to support the development of DOE Oversight and Staffing Plans, which were also completed.

The recommendation regarding planning for LSIT and the need to integrate the engineering design and cold commissioning testing is not complete. While many preliminary actions were completed, the final LSIT test plan is not finalized.

BNI evaluated and updated the risk register for Operations engineering resources and developed a baseline change proposal (BCP) that transfers the risks to DOE, i.e., additional costs will be taken out of the contingency held by DOE. The issue remains open because budgetary resources are not approved and will be needed to support startup and commissioning in the near term. Issues related to the lack of system engineers will likely affect schedule deliverables before the next Construction Project Review.

3.1 Findings

DOE WTP has created a Startup and Commissioning Organization to ensure that the construction, commissioning and operation of the WTP facilities are coordinated and conducted appropriately. This office will be responsible for developing the processes, as well as monitoring progress and conducting oversight of the activities supporting the progression from construction

startup to commissioning and operations. It will also interface with the Tank Farms project to ensure the timely availability of tank waste feed to support future operations of the plant following completion of the WTP Project.

DOE has developed a start-up staffing plan that describes the processes, procedures and staffing roles, responsibilities, and authorities to oversee the startup of LBL for the period between construction completion and finalization of startup testing. It does not address oversight of cold commissioning, hot operations, or facility acceptance.

DOE's startup plan is based on prioritizing systems into three categories: Priority 1 systems are nuclear systems and those systems that have Technical Safety Requirements (TSRs); Priority 2 systems are those that control chemicals or other significant hazards; and Priority 3 systems are the remainder of the systems within the facility. Systems are prioritized so that the most important systems receive the most attention. The system priority determines the level of oversight and the type of qualification for the lead person assigned responsibility for that system. Priority 1 systems will be sampled at a rate of approximately 30% for oversight by DOE by a Safety System Oversight (SSO) qualified engineer. Priority 2 and 3 systems receive less oversight, approximately 10 percent each. These sampling rates need further discussion and review.

BNI has created an Integration, Startup and Completions (ISC) Organization since the last CPR. This group is responsible for overseeing Startup, EPC (engineering, procurement, and construction) Completions, Hanford Complex integration with WTP, and the Large Scale Integrated Testing Program, as well as actively engaging in the commissioning phase. In addition, this group is responsible for mechanical acceptance (startup, component and system testing), completions, punch list administration, and turnover coordination. The DOE Startup and Commissioning Integration organization is responsible for oversight of BNI's ISC organization

The primary function of the DOE Startup and Commissioning Integration group will be to integrate four prime contractors. Currently these contractors have different fee schedules and corporate expectations. Integration roles and responsibilities are being developed and evolving. The task of integrating multiple contractors with different contracts, philosophies, and financial incentives, along with customers from multiple parts of DOE is complex, but absolutely critical to the Hanford waste stabilization mission.

Hydrostatic tests, alignments, and other basic tests prior to turnover of systems to startup will be completed during the construction phase. Once these construction acceptance tests are complete, the systems will be turned over to the test organization.

The BNI engineering organization will develop systems descriptions and establish test acceptance criteria (TAC) for startup. Operations and maintenance personnel will also become familiar with the systems and operations during the test phase. Flushing and component and systems testing will be conducted consistent with the system descriptions and evaluated against the TAC.

BNI as the design authority is responsible for ensuring that the TAC are met for each system, as well as reviewing test procedures and results. Failure to meet the TAC will result in test deficiency reports being written to engineering for disposition. This will support demonstration of readiness to proceed with water runs and cold commissioning. Once system tests are complete and deficiency report issues resolved, systems will be turned over to Operations for commissioning.

Startup risks have been identified and are being tracked. The most significant item is ISC-009 where the startup testing baseline is predicated on a success oriented approach with a single satisfactory test of performance for each system or component and no provision for failure. This may result in additional costs and negative schedule float in the event of rework resulting from a failed test. This was a concern of the previous review and has not yet been addressed. Other risks not in the risk register, but being evaluated, include inadequate forecasted overtime rates, startup consumables and spare parts. There are also risks associated with the Unreviewed Safety Question (USQ) screening process that will be implemented before component and system testing is completed.

BNI is currently working on a number of activities in preparation for commissioning. These include drawing and document reviews, witnessing software and vendor tests, and Integrated Safety Management (ISM) reviews to establish facility safety controls. In addition, some initial work with the Tank Farms is ongoing to establish waste feed prequalification requirements to ensure that subsequent WTP operations meet regulatory, safety and processing requirements.

As commissioning operations progress in conjunction with facility completions, it is anticipated that the Campaign and Batch Sheet Process report for LAW will be revised. This will be necessary to determine operability and testing requirements as well as completing the

associated facility commissioning activities schedule. For LBL, the Plant Operations Support Activities Schedule and the Commissioning Test Requirements Database will need to be completed. The Management and Operations Manual for the commissioning phase and the Integrated Safety Management System Phase 1 verification preparation plan will also need completion in preparation for commissioning.

WTP will be utilizing the Data Quality Objectives (DQO) process to sort requirements and define data quality necessary to receive wastes, process wastes, and produce vitrified waste. An optimized regulatory DQO and initial waste acceptance criteria (WAC) have been completed. The WAC DQO identified gaps in the analytical methods for waste feed prequalification. The DQO process is iterative and will incorporate results from the large scale integrated tests and Tank Farm tank mixing studies.

A commissioning readiness verification matrix will be utilized by the WTP to identify prerequisites for each phase of plant operations. These phases include construction to startup, startup to commissioning, water runs, cold commissioning, and hot commissioning. The draft for Low Activity Waste (LAW) is being prepared.

Test specifications for commissioning simulants have been prepared by BNI and are in final comment resolution. Simulant development activities are expected to be complete in CY 2013. The plan currently calls for a primary base simulant and the ability to modify it with additives for aluminum, chromium, etc., for testing environmental control systems. Secondary simulants will be utilized in transfer testing between facilities.

The current approach assumes that cold commissioning will use simulants with “average” properties. Initial large-scale integrated test (LSIT) simulants are intended to demonstrate mixing at design basis conditions. LSIT simulants will be made progressively more difficult to mix in order to identify performance limits and establish safe operating margins. Properties to be considered include larger particle sizes at known densities, non-Newtonian yield stress, shear strength of settle slurry, and increased solids loading slurries.

A Facility Acceptance and Transition Organization was established by BNI to interface with the EPC completions manager to promote efficient turnover of systems and facilities for commissioning phase activities. This organization will manage the transfer of systems from startup to plant operations, building and area turnovers, outage management, and transition to the WTP operations contractor. System and area turnover processes, as well as roles and responsibilities, are defined in project-level procedures.

The training processes at the WTP are well designed and being implemented. The WTP project has assigned operational procedures and training curriculum to a single manager. This will assure integration among procedures and training – an issue at some sites. Further, the manager has continued to maintain his original baseline schedule and created opportunity for project cost savings.

Plant engineering has begun evaluating the manner in which design engineering will transition to plant engineering. As design nears completion, some system design engineers will be able to transition to become plant engineers and continue to support operations and commissioning. The transition plan is scheduled to be completed in August 2012.

Safety Culture attributes should be included in commissioning and startup programs and plans.

Environmental and Nuclear Safety (E&NS) staffing risks for Documented Safety Analysis development and commissioning and operations support have potential for adversely affecting commissioning and startup.

The commissioning risk program maintains 13 threats and 3 opportunities. Significant threats include plant engineering staffing ($41.5M), transition of Environment Safety, Health and Quality Programs to support commissioning ($10.7M) and impacts of potential design changes related to hydrogen, pulse jet mixers and fire protection ($5.9M). Total plant-operations risk related to the commissioning program is $95M, including the items listed above.

A management assessment was completed by BNI of the current Low Activity Waste preliminary documented safety analysis (PDSA) to help determine the scope of work needed to prepare the final DSA. The results of the assessment identified specific deficiencies and safety-basis development process changes that need to be implemented to effectively plan and perform DSA and TSR development. Two items were added to the risk register to address issues related to the DSA: engineering and nuclear safety resources necessary for DSA development ($50M), and the corresponding resources to support commissioning and operations ($48M).

3.2 Comments

An insufficient number of system engineers and nuclear safety personnel compared to the staffing plan represents a significant risk to the project as it prepares for startup and

commissioning. A large turnover of systems from construction to operation begins early in 2012 and knowledgeable contractor Cognizant System Engineers will be needed at that time. The time necessary to train personnel to become proficient on the job is approaching a critical point for these personnel to be productive in time for system turnover.

System engineers are also needed to develop operations procedures that ensure safe operation and to conduct operability evaluations. Environmental and Nuclear Safety (E&NS) staffing risks for Documented Safety Analysis development, as well as commissioning and operations support, have potential for adversely affecting commissioning and startup. If plant configuration changes are needed, it can be extremely difficult to do during commissioning. The commissioning risk associated with staffing for the System Engineering program as defined in DOE O 420.1B has been transferred to DOE.

The commissioning schedule has little margin for equipment failures and configuration changes. Resolution of open design issues, including applicability of DOE STD 3009, also has potential for adverse schedule risks on startup and commissioning, and is discussed by the ESH&Q Subcommittee; see their Recommendation 5.

The training classroom provides an opportunity for a dedicated cultural safety message to the employees. Appropriate testing provides a means for management to receive and evaluate objective feedback regarding the effectiveness of its cultural message. WTP management has not fully considered how to incorporate safety, compliance, and quality culture messages into the training curricula.

Traditional training programs explain the rules and requirements of a functional area (e.g., criticality safety), and the consequences of a failure to follow the requirements and procedures. Incorporating safety culture messages into the curriculum extends this training to include an understanding of habits and conditions that could prevent safety requirements from being followed. The intent is to encourage a questioning attitude so operators can identify unexpected conditions and prevent events from occurring. This skill is particularly important in a startup and commissioning environment for a one-of-a-kind plant where unexpected conditions are certain to arise. Procedures and Training must be augmented by common sense and an alert and questioning attitude embedded in a strong worker safety culture to assure safe operations. Summarily, traditional training is about requirements and actions. Culture is about expectations. Each module of the startup and commissioning training program should include examples of lessons learned from events that could have been prevented had a stronger safety culture been instilled. These lessons-learned examples should have a theme where the operators were trained,

followed procedures, but nonetheless experienced an event. The examples should be taken from the startup and testing of complex systems similar to WTP to the extent practical.

A Certification and Verification Plan will be prepared two years prior to the operational readiness review (ORR) to verify readiness to begin waste processing operations. This plan will describe DOE's process to verify line management's knowledge of readiness.

A comment from the November CPR noted that the total risk carried for component and system testing is about $2M for a $1.1B sub-project. Risk item ISC-009 from the July 2011 Risk Register includes a $2.1M risk stating "Startup Testing Baseline is Based on Single Test Performance." About 160,000 components will be considered for testing as shown in the table. Nearly 11,000 tasks will be executed.

Facility	Number of Components
LAW	30,580
BOF	19,672
Lab	9,253
PT	61,815
HLW	37,261

Experience on projects of similar size and complexity shows that 25% rework can be expected. Some components and systems will be approaching twenty years old when tested and this may result in higher failure rates. A risk value of $2M implies that the average component test (not all components will be tested, but systems are not included) includes a risk cost of $1300 per component. Alternatively, assuming a retest rate of 25% at an average cost of $10,000/retest for 111,000 tasks, the current risk value may be low by over a factor of 10. In addition, there may be schedule slippage and associated costs from failures that require rework and further testing.

The project is anticipated to encounter risk related to configuration control during commissioning. This risk is difficult to quantify, and therefore not captured on the risk register. BNI has implemented many systems to address configuration control risks during commissioning. However, configuration control will be challenged for several reasons:

1. Completion of the large-scale integrate test (LSIT) is anticipated to result in changes to systems and components and their attendant performance specifications. This will

be completed relatively late in the project, and will affect documents under configuration control (e.g., safety basis documents, procedures, and training).

2. The late arrival of a reduced number of system engineers coupled with schedule and cost pressures that exist during all major commissioning programs would increase the risk of configuration control errors.

3. BNI is evaluating a parallel, critical path for completion of the pulse-jet-mixing studies while finalizing the design for pretreatment. This is an appropriate action for the project. However, this parallel path may result in changes to the design and attendant documents and processes requiring configuration control, including safety documentation. Given that this would occur late in the process on a parallel path, there may be unexpected issues with configuration control as a root cause.

3.3 Recommendations

Recommendation 1 – DOE-WTP should direct BNI by November 2011 to establish and staff a DOE O 420.1B Cognizant System Engineering program to support the Startup and Commissioning schedule.

Recommendation 2 – BNI Startup and Commissioning should integrate Safety Culture attributes and behaviors into program development and training by December 2011.

Recommendation 3 – BNI should develop processes by January 2012 to maintain the configuration of design and the safety basis during Startup and Commissioning.

4. ENVIRONMENT, SAFETY, HEALTH, and QUALITY ASSURANCE

The Environment, Safety, Health and Quality Assurance (ESH&Q) Subcommittee was charged with determining whether the ESH&Q programs, controls, and processes are sufficiently mature for the project's current stage of development and whether the project responded appropriately to previous CPR review recommendations. Although deficiencies with out-of-date technical databases supporting the Preliminary Documented Safety Analysis (PDSA) are a new concern, the maturity of other ES&H and Quality programs continues to be commensurate with

expectations for design and construction projects. All recommendations from the previous CPR have been appropriately closed.

4.1 Findings

DOE reviewed and approved the WTP PDSA at Critical Decision 3. Subsequent to that approval, significant PDSA changes have been made to account for modifications to facility design (e.g., replacing a passive LAW process vessel vent (PVV) system with an active system). In addition, safety analysis methodologies (e.g., pressurized spray leak) were submitted to, and approved by, DOE. However, key technical baseline documents (e.g., hazard analysis and accident analysis) were not consistently updated to support PDSA revisions submitted for DOE approval. Consequently, the project cannot demonstrate facility design and PDSA controls are supported with an analysis that bounds hazards present within the WTP facilities.

In May 2010, the ESH&Q subcommittee previously reviewed risk register items related to ESH&Q and made a recommendation related to the need to establish mitigation strategies for some of these risk register items. In November 2010, the CPR team considered the recommendation to be closed once risk-handling strategies were defined for these risks; however, risks are still being carried for these items.

The procurement effort at BNI for the WTP project is continuing to move from bulk items through major equipment and into instruments and controls. Purchases of bulk wire and cable are ramping up as purchases of bulk pipe are ending. Major equipment delivery is expected to wrap up in 2014. Purchases of instruments and controls are expected to continue for at least the next three to four years. Receipt of vendor documentation is being handled under the G-321-V process, which requires all documentation to be in place prior to release of items for delivery to WTP. Exceptions to this process can be made using the Provisional Release to Ship process; this process has been used approximately 30 times at WTP.

BNI is making significant efforts to ensure delivered items meet the quality and functional requirements specified in the purchase order. The supplier evaluation process has been enhanced over the past two years and additional vendor support tools have been implemented. BNI has developed Guide 2490-WTP-GPG-AS-0023, Effective Supplier Nuclear QA Practices, to help vendors understand what actions are necessary to implement nuclear quality programs. The guide is available as part of a web site that has been implemented by BNI to help suppliers understand the expectations of nuclear quality programs. Also, the Vendor

Review Board formed as part of the Vendor Commercial Grade Dedication investigation has been retained to review the performance of suppliers.

The subcommittee concluded that all required environmental permits have been initially established for the construction and operation of the WTP facility. A permitting program has been established to develop, obtain, modify, and maintain environmental permits. The subcommittee reviewed the project's permit process to assess whether it was sufficiently integrated with facility completion schedules, to give regulators adequate time to review permit deliverables.

An Environmental Plan and procedures exist to coordinate the preparation, review and approval of permit modifications as the design and construction of the facility changes. The responsibility and methodology for preparing and updating each of the required permits and permit-required reports, documents and modifications are clearly defined, understood and reflected in procedures.

The Resource Conservation and Recovery Act (RCRA) Waste Processing Facility Dangerous Waste Permit requires the submittal of a Demonstration Test Plan (DTP) to establish operational parameters that will demonstrate system performance with regard to the treatment and control of emissions from the treatment of hazardous mixed waste in the WTP facilities. The DTP must be approved by the Washington State Department of Ecology (Ecology) prior to conducting the Performance Tests for the facilities.

DOE ORP environmental staff is keeping pace with the permitting needs of the project. As the project progresses and moves into commissioning, the need to hire 1-2 additional environmental staff to supplement the team is recognized and approval has been requested.

BNI has developed the Hanford Tank Waste Treatment and Immobilization Plant Environmental Plan to address WTP Contract deliverable 7.3, which requires a plan be developed that identifies a structured approach for environmental protection, compliance and permitting. The Environmental Plan includes descriptions of the planned environmental permitting and compliance activities for design, construction and commissioning the WTP. It also contains detailed permitting and compliance schedules, integrated and linked to the technical baseline.

The Suspect/Counterfeit Item (S/CI) program has added additional Proforma requirements to require purchase of electronic components from authorized distributors or directly from the manufacturer.

BNI intends to use the requirements of NQA-1 to develop the validation process for the Computational Fluid Dynamics code FLUENT, using ASME V&V 20.

Revision 3 of the ESH&Q Programs Personnel Transition Plan is in final draft. This revision closes risk register OPS-21. The document is expected to be finalized by early September 2011.

BNI has developed and implemented extensive engineering and administrative controls for protection from falls.

4.2 Comments

BNI recently self-identified the fact that some hazard and accident analyses are outdated and there are gaps in the Design Control Database (DCD). A Preliminary Documented Safety Analysis (PDSA) supported by hazard and accident analyses that are inconsistent with design is not technically defensible. The Environmental and Nuclear Safety (E&NS) Manager has concluded that the DCD does not preserve all of the nuclear safety information applicable to design; further, the BNI issue management system has not been effectively used to manage issues related to implementation of the hazard analysis process. Specifically, items opened to address PDSA technical bases and safety basis inputs to design were closed without agreement between the Engineering and Nuclear Safety organizations. Senior management attention from both DOE and BNI is needed to resolve the impasse between the Engineering, Contracts, Legal, and Nuclear Safety organizations regarding the applicability of nuclear safety regulations and standards.

E&NS resources assigned to Area Project Managers are insufficient to support the current work scope and schedule as well as make a transition to commissioning/operations. This is evidenced by the growing backlog of technical baseline document reviews by Nuclear Safety.

Due to the complexity of the Demonstration Test Plan (DTP), as well as the potential need to negotiate and receive approval from the Department of Ecology, the DTP will likely undergo several revisions prior to being approved. Since the DTP must be approved prior to

conducting the Performance Test for the facilities, the 2018 submittal date will not support a 2016 start date for LAW facility and could adversely impact the 2018 HLW facility start date.

A draft DTP was written in 2006 but put on hold. To mitigate any potential start up delays, it would be optimal to resume work on the DTP within the next six months. This lead time is necessary to identify operations issues, waste feed issues, sampling and monitoring issues, establish operational parameters, and resolve any issues with regulatory agencies, as well as maximize the opportunity to conduct successful Performance Tests on the LAW and HLW facilities to meet project milestones.

The WTP utilizes an unconventional permitting strategy in that units are permitted as the facilities are being designed and constructed. This method has required hundreds of permit modifications since project inception and will continue until completion. This process is extremely resource intensive. Each modification must be prepared, coordinated, reviewed, submitted to Ecology for approval and tracked to completion.

BNI is currently keeping pace with the resource needs to process the permit modifications needed for construction. However, at this time, resources are not available for permitting activities necessary for the commissioning phase. BNI recognizes the need to hire additional resources and has identified this as a risk (ENS-008), but has not implemented a staffing plan. A Trend/Change Notice should be developed for ENS-008 and a staffing plan implemented to address inadequate resources for Environmental Permitting.

The Washington State Department of Ecology may not be adequately staffed to support the permitting needs of the WTP facility. There has been a large turnover in the past two years and currently both Lead Engineering and Lead Permitting positions are vacant. Although this has not caused any project delays to date, it may cause future project delays due to the staffing shortage, as well as the need to "re-familiarize" new hires with the WTP project and permitting process. Also of concern is the loss of continuity with regard to previous decisions and determinations impacting the regulatory or permitting framework for the permits. It should be noted that Ecology has been very cooperative in working with BNI on environmental permitting issues.

Environmental Permit requirements have not yet been incorporated into operational procedures. Permit conditions are currently maintained in the DOORs database which is primarily used for tracking at this time. BNI has not yet identified a process to accomplish the

flowdown of the permit conditions to the operating procedures. A draft Trend/Change Notice is in development for this activity.

The Environmental Plan is outdated and should be updated to reflect the current permitting schedule, compliance timeframes, project milestones and procedure changes. The Environmental Plan also references environmental procedures, guides, and desktop procedures to manage the permitting process, and interfaces as well with permit maintenance procedures. These areas should all be reviewed for improvement and updating where necessary, particularly as the project moves from construction to commissioning.

The WTP Dangerous Waste Permit (DWP) is currently 20 volumes in size. The majority of the permit consists of documents required by Ecology to support the hundreds of design change permit modifications (Piping and Instrumentation Diagrams (P&IDs), engineering design packages, etc.), which may not be required as part of the Permit proper, but are typically used as supporting information and documentation maintained in operating or administrative records. BNI recognizes the need to streamline the Permit to capture the necessary information in a more concise and condensed format. A strategy should be negotiated with Ecology to develop a streamlined format that captures the required information but reduces the volume of information currently included as part of the Permit proper.

Currently, several WTP tanks must undergo structural modification to address seismic or erosion issues. Permit modifications are required to be submitted and approved by Ecology prior to the installation of these tanks. The permit modification packages are dependent on engineering design packages that may not be completed in time to allow preparation and processing of permit modifications to meet project schedules and Consent Decree deadlines for construction. In an attempt to mitigate project delays that result from this, WTP should work with Ecology to allow the use of a permit modification process that allows Temporary Authorization for the modification ahead of formal approval. This will not be the case for the majority of modifications. However, as the project progresses, there are likely going to be additional critical path items that will require an expedited approach to prevent project delays.

Planning for long-term RCRA-permitted storage capacity to accommodate both the HLW and the LAW facility requirements is needed in the event the De-Listing Petition, the Treatability Variance, and the Waste Incidental to Reprocessing (WIR) Determination are not approved or are delayed.

Little progress has been made or is anticipated on crucial regulatory determinations needed from EPA and DOE that affect final disposition of HLW and LAW products.

BNI has been upgrading the Suspect/Counterfeit Items (S/CI) program in response to the recommendation in the November CPR. An S/CI Coordinator has been designated; BNI has added S/CI wording to the Proforma purchasing requirements requiring suppliers to purchase electronic components either from the original manufacturer or from authorized distributors; and an independent assessment of the BNI S/CI program has been performed. Further, the S/CI checklists used at vendor assessments have added more specificity regarding S/CI; the S/CI training program has added general information to raise awareness about electronic components; and Wholesale Electric is now reporting S/CI identifications at Wholesale Electric to the BNI Subcontract Administrator.

The subcommittee believes additional actions to harden the S/CI program against introduction of counterfeit electronics are warranted, including adding electronics-specific items to the supplier evaluation checklists to verify that the vendor is implementing the new Proforma wording, and providing more specific training on identifying potential counterfeit electronics to persons involved with acceptance of electronic components. BNI should also verify that the S/CI Coordinator is receiving the information supplied to the Subcontract Administrator by Wholesale Electric.

BNI has stated that validation of the FLUENT code will be done under the requirements for software validation contained in ASME NQA-1. This validation testing is planned to be subcontracted to the DOE National Energy Technology Laboratory (NETL). One of the tools to be used in the validation is ASME Standard V&V-20. This standard has specific limitations regarding extrapolation or interpolation of the results across the analysis domain. DOE should review the validation plan to ensure that these, and any other limitations contained in the standard, are addressed by the validation plan and that the overall testing and validation program meets the requirements of DOE O 414.1C and the NQA-1 standard. The sources of the data used in the validation process should also be reviewed to verify that data used to qualify the code are accepted using processes acceptable under DOE Order 414.1C and the NQA-1 standard.

Factory acceptance testing is evaluated, observed, and approved in accordance with PEQ-DI-01, Guidance for Factory Acceptance Testing. This desk instruction contains important information to help BNI guide vendors and evaluate factory acceptance testing to ensure the testing verifies the critical functional requirements. Approving vendor factory acceptance testing plans and evaluating the testing results to verify the performance of safety-related systems or

components are quality-affecting activities that should be performed under an approved procedure. The desk instruction PEQ-DI-01 should be officially designated as the procedure (or plan) to be used.

A comprehensive fall protection procedure is in place that includes roles and responsibilities, training, requirements for proper use of fall prevention systems, and equipment inspections. The subcommittee review included a general walk down of several activities in the field that involved fall hazards such as receiving materials at upper levels, aerial lift work, roofing, piping installation, and form placement. Several types of fall prevention were observed and included guardrail systems, fall arrest systems and work platforms.

A recent change to the fall protection procedure requires the use of self-retracting lifelines when workers are on scissor lifts. A number of lifts were reviewed for correct use of anchorage points for the lifelines and no noncompliances were observed. A specific review of a representative work package ((PCS0093-00) was performed. The Assisted Job Hazard Analysis (AJHA) and the Safety Task Assessment Risk Reduction Talk (STARRT) card both included the use of aerial lifts with the requirement for use of personal fall arrest system. Also, a Lessons Learned from another DOE facility fall incident was included in the work package. Inspections of personal fall-arrest systems are required in the procedure and a sampling of equipment found the inspections up to date.

The subcommittee reviewed the status of the root cause analysis being performed for the "Girt Drop Event." The event happened June 15, 2011, and involved an 18-foot, 548-pound, side support girt on the south side of the Pretreatment Facility that fell 62 feet to the ground. Although the final report has not been finalized, the review team found the preliminary analysis to be comprehensive, extensive and performed by a qualified and experienced team. The preliminary root/contributing causes, corrective actions, and judgment of needs have been drafted and final review and completion of the report should happen in the near future. Until then, girt installation at the Pretreatment Facility continues to be suspended.

The "Safety Impact Plan" has been updated and finalized for 2011. A focus area under the "Help Supervisors Become Better Safety Leaders" header includes an action for supervisors to monitor work and ensure it is being performed in accordance with work package controls. The Senior Supervisor Watch Program continues to mature and participants are providing timely feedback to workers and the Manager of Construction. Additional members of senior leadership have been added to the roster.

The Heat Stress Program is being effectively implemented at the site. During the site walk down, "cool rooms" were available and provided comfortable cool "zones." A noteworthy practice is the use of text messaging to broadcast Wet-Bulb Globe Temperature (WBGT) to site supervision. The information is then compared against a pocket-sized card to add additional minutes to worker break time if necessary. The process provides an efficient method for providing timely, site-wide heat stress management.

At the time of the review, the WTP Total Recordable Case (TRC) rate for 2011 to date was 1.11, up from 0.73 in 2010 and more than of the project goal of less than 1.0. A review of the types of injuries indicates that eye and finger/hand injuries are the most prevalent. Prevention of these injury types has had extensive resources dedicated to them in the past as noted in the November 2010 Construction Project Review.

While BNI continues devoting significant effort to educating workers on at-risk behaviors for hand/finger and eye injuries, the updated "Safety Action Plan' has been implemented as well. One expectation of the plan requires project supervision to dedicate more time in the field confirming work is being done with the proper personal protection equipment. This added field oversight should reinforce management's commitment to safety and provide worker feedback to help reduce at-risk behaviors.

4.3 Recommendations

Recommendation 1 – BNI should complete the initial draft of the Demonstration Performance Test Plan by March 2012.

Recommendation 2 – Establish and implement a process to incorporate Environmental Permit conditions into BNI operational procedures by March 2012.

Recommendation 3 – Obtain agreement between WTP/BNI and the Department of Ecology by March 2012 for utilization of the Permit process which allows Temporary Authorization for modifications (having potential to cause project delays) to proceed in advance of formal approval.

Recommendation 4 – By December 2011, BNI should demonstrate to DOE-WTP that the Environmental and Nuclear Safety organization has the resources necessary to meet project nuclear safety and environmental requirements on schedule.

Recommendation 5 – By October 2011, resolve the internal BNI conflict regarding the applicability of DOE Standard 3009 and the applicability of 10CFR830 to commissioning and testing.

Recommendation 6 – BNI should complete an extent of condition review by March 2012, to determine which PDSA revisions are not supported by a technical basis.

Recommendation 7 – Develop a BNI plan by May 2012 that ensures all credited safety functions/functional requirements are preserved as design inputs.

5. COST, SCHEDULE, and RISK

The Cost, Schedule, and Risk Subcommittee was charged with the following questions:

Are costs and schedule estimates-to-complete, including the risks and contingency, reasonable and achievable? Significant progress towards completing the WTP project has been made over the past two years, primarily due to the actions taken by the new management and leadership teams on both the BNI and federal sides. The project has reached the 60% completion mark as of the end of July 2011. However, the successful completion of the WTP project within the approved Total Project Cost (TPC) of $12,263 million remains a formidable challenge. With the continuation of unresolved technical issues, identification of new risks, and realization of existing risks, the limited amount of unencumbered contingency and management reserve (MR), referred to within the project as "headroom" and calculated by BNI to be $278M, will likely not be sufficient.

Are construction activities proceeding as scheduled with focused constructability reviews to continuously improve the overall effectiveness and schedule? Physical progress continues with 84% of the design/engineering; 60% of the procurements; and 56% of construction activities being completed; however, design issues continue to impact construction execution. Further, the potential FY12 funding shortfall of $100M against the approved plan is resulting in a deferral of planned staffing increases needed to support the current working schedule. The committee also noted that the craft unit-installation rates that form the basis of estimate are not being met.

Were the recommendations of the last review appropriately addressed? Yes.

The risk management and opportunity process continues and aggressive implementation by BNI has yielded significant benefits towards maintaining the project cost and schedule targets. Mitigation actions and opportunities realized or in process have accounted for $264M in savings or cost avoidances since the last review. In addition, the committee believes that the continued application of this combined management approach could support completion to within 5% of the TPC, based on the assumption that the current contract funding profile will be provided. Further cost avoidances may result from the review and potential implementation of other technical approaches presented to the broader committee.

5.1 Findings

The approved TPC remains at $12,263 million with a budget at completion (BAC) of $10,560 million (Table 1 below). Assuming that the phased CD-4 baseline change proposal (BCP) is approved, the combination of management reserve and contingency is currently $876 million (see Appendix D) or 20% of the BAC work remaining ($4,467 million). The major WTP project milestones are shown in Appendix E. As reported by the Federal Project Manager in his July Monthly Project Review, the schedule contingency is 7 months. The current control account manager (CAM) estimate at completion (EAC) is $10,733 million, excluding risks and opportunities. The BNI Project Manager's EAC, including risks and opportunities, best case, worst case, and most likely case are $11, 077 million, $11,601 million, and $11,124 million, respectively (Performance Measurement Baseline (PMB) only). The Federal Project Director's EAC is $12,263 million, which includes fee, DOE costs, and contingency. The assumed funding profile model is shown in Appendix F. Using July data for available MR, the CAM estimate at completion indicates a need for $64M of additional MR.

Table 1. Budget at Completion

PT	HLW	LAW	BOF	LAB	SS	TOTAL
$2,490M	$1,490M	$950M	$530M	$350M	$4,750M	$10,560M

Physical progress continues with Table 2 showing completion of design/engineering and construction activities by facility.

Table 2. Percent Complete by Facility

Facility	Engineering Complete	Construction Complete
PT	80%	38%
HLW	88%	35%
LAW	91%	64%
LAB	82%	65%
BOF	79%	62%
Total Project	84%	56%

5.2 Comments

Based on the current approved funding profile, the committee has identified a potential overrun of approximately $800-$900 million based on the current risks identified and an extrapolation of past risks being realized at the recent historic WTP Project rate. This can be offset partially by a $350 million opportunity presently in the change control process to implement a phased critical decision (CD)-4 approach.

The committee's analysis utilized data provided by the project team in advance and during the August 2011 site visit. This analysis begins with the current Estimate-to-Complete (ETC) for the project as of the end of July 2011, and includes actual costs to-date, DOE costs, and estimated contractor fee. To this total, we add the outputs from the project's Monte Carlo analysis of threats (both risk events and inherent estimate uncertainties) and opportunities at an 80% level of confidence, including the cost impact related to schedule contingency duration.

The project risk analysis provided to the committee (summarized in Appendix D) assumed approval of the phased CD-4 BCP. It showed that a total of $626M will be needed to address known engineering, procurement, construction, and commissioning (EPCC) risks, and therefore should be viewed as potentially required MR. The current analysis identifies a surplus of $28M to address current DOE risks, largely due to the included opportunity associated with the phased CD-4 approach and the assumed resultant transfer of some project scope to operations outside the TPC. Under this assumption, the combined total of $598M represents 14% of the current ETC. Including the remaining available "head room" of $278M, the available MR plus contingency totals $876M, or 20% of ETC.

The Subcommittee's analysis assumes that the current funding profile will be provided and includes the following adjustments to the project's ETC and risk analysis:

- The BNI project team reduced the results of the Monte-Carlo risk analysis by accounting for the impacts of an aggregate analysis (simulation of the entire project, rather than simply adding the 80% confidence values for each identified risk), as was recommended by earlier construction project reviews (CPRs). We chose not to take this adjustment for our analysis. We believe certain risks and uncertainties are in fact closely related and by treating these as independent variables in the analysis of the entire project, there may be some understatement of the overall risk impact on the project. By eliminating the aggregate adjustment, we believe we are offsetting this deficiency in the project's analysis, at least to some extent.

- The project tracks the actual realized values for both threats and opportunities that are realized on the project through trends and baseline change proposals (BCPs). Actual threat impacts have been slightly more than had been estimated (by a factor to-date of 1.06) while actual opportunity impacts have been less than estimated by the risk program (0.82 factor to-date). The committee used these actual performance factors to increase the project's current estimate of potential threat impacts and reduce the project's current estimate of possible opportunities accordingly.

- Over the past year, the project has seen a consistent trend of newly identified threat impacts growing faster than the impacts of newly identified opportunities. Specifically, in the ten months preceding this CPR, the project has averaged a net growth in the risk forecast (threats less opportunities) of $21.6M per month with the only exception being the impact of the phased CD-4 opportunity. The committee believes this trend may continue in the foreseeable future and has assumed two more years of such growth in net risk impacts.

The total of our forecast, including the above-discussed adjustments but not the potential savings to the Project from the phased CD-4 BCP, is a TPC of approximately $13.2B, which includes an allowance for MR and contingency of $1.4B that represents 32% of the current ETC for the project. Assuming that the current approved funding profile will be available, the committee has thus identified a potential overrun of $800-$900 million based on the risks identified and an extrapolation of past risks being realized in the future. The opportunity to implement the phased critical decision (CD)-4 would reduce this by about $350M.

If the BCP for the phased CD-4 is approved, the project will transfer some baseline commissioning scope, with the associated risks, out of the TPC and into operations within the DOE Office of River Protection (ORP). At this time, the BCP is in the baseline change control process and from there will be submitted for Acquisition Executive (S-2) consideration. The net effect of this BCP will be to shift hot commissioning scope post-CD4, along with associated risk,

for each of the major facilities from the construction project to the operations activity outside the project TPC. This action will remove approximately $223M of scope from the TPC as well as an associated $61M in estimated risk impacts. Together, these changes yield a potential opportunity of approximately $284M, as captured in the WTP risk program. When a potential reduction of BNI fee is included, this opportunity increases to almost $350M.

The Committee endorses this phased CD-4 opportunity, and recognizes it is highly unlikely that the WTP can be completed within the current project budget without implementing this changed approach. However, it must be understood that these costs do not go away – they are merely being transferred out of project space. These activities, and the costs and resources needed to accomplish them, must still be made available within the overall program at ORP.

With respect to schedule performance, the Committee found that between January and July 2011, nearly 7% of the remaining to-go schedule activities (1,260 activities out of 18,620 activities) were moved out to later dates. The movement of these activities, along with accomplishing all the other planned work, and completing selected work ahead of plan has enabled the WTP Program to stay on or near 1.0 SPI (schedule performance index) during FY2011 and the project-to-date.

The committee has a concern about this practice of moving out of the near-term window (3 – 6 months) work that cannot or will not be accomplished, namely that a "bow wave" of work will begin to accumulate in the remaining period of performance. When this bow wave of work can no longer be moved to a later period, the amount of critical and near-critical schedule activities will rise dramatically. These activities will then represent a large block of work that must be accomplished in a short amount of time. As the amount of critical and near-critical activities rise, the risk that these activities cannot be accomplished on schedule and on budget will also rise due to trade stacking, craft labor availability, and greater impacts associated with material or engineering holds.

So, while using the "Call the Pocket" program works to identify activities that cannot be accomplished in the near-term window and moves this work to a later period of performance, it easily could be masking the risk of a bow wave being created that will create execution problems in the future.

The committee believes that the CAM EAC determination of the craft unit rates appears to be optimistic as commodity installation rates are currently below the planned installation rates. The commodity performance indices for the past six months are presented in Table 3, where, for

example, the actual rates for electrical and steel installation have been typically 75% of that planned.

Table 3. Commodity Performance Indices

Month	Electrical	Piping	Concrete	Steel
Jan 2011	.70	1.03	1.01	.58
Feb 2011	.84	.89	.94	.69
Mar 2011	.66	.94	.86	.76
Apr 2011	.74	.88	.89	.72
May 2011	.72	.87	96	.77
Jun 2011	.68	.81	.98	.75

Although the BNI risk management program is considered excellent, some significant technical issues have yet to be captured in the risk program, and some risk events that have occurred are not consistently being incorporated into the baseline in a timely manner. In addition, threat identification (cost growth) continues to out-pace the identification of opportunities (cost savings).

During our review, it became evident that there are some significant threats that have not yet been fully identified or sufficiently understood to be incorporated into the WTP risk program. Because the impacts of these risks, as well as their probability of occurrence, have not yet been estimated, the committee has not included them in our current forecast of the possible project TPC as discussed above. These threats include the following, details for which may be found or inferred from discussions of the other CPR subcommittees in this report:

- While the estimated cost for conducting the Large Scale Integrated Testing (LSIT) is captured in the WTP risk program, there are no risk allowances identified for subsequent physical changes to plant design, equipment, systems, etc. that might be shown to be required by such testing. The cost of these physical changes to the plant, if they should in fact be needed, may be significant.

- There are many risks dealing with various technical issues identified by the project that appear to only capture the potential cost and schedule impacts related to the analysis and engineering/design aspects of these issues. As with LSIT, there do not appear to be taken into account any associated risk impacts from physical changes to the plant as a result of these analyses.

- The plan for startup testing assumes a single satisfactory test of performance for each system or component with minimal provision for failure. This may result in schedule slippage and additional costs from failures requiring rework and further testing.

- The deficiencies identified in the configuration control program as related to the WTP Safety Basis documentation have not yet been fully assessed from a cost and schedule impact perspective. In addition, the risks (in particular, threats) associated with these elements are not yet captured in the risk program. At the time of this review, it was not possible to assess the potential cost and/or schedule impacts related to this issue.

As stated in our analysis of the forecasted TPC above, the committee was provided information being tracked by the project team that demonstrates a consistent trend over the past year whereby newly identified threats are outpacing opportunity recognition for the project. While we have extrapolated two more years of such growth in potential risk impacts for the project in our analysis, we emphasize that it is essential that the project team attempt to get this situation under control as soon as possible in order to contain the project TPC in a reasonable manner. The changed technical approach for the project, namely, to target problematic wastes for later treatment after WTP operations are mature, recommended by the Technical Subcommittee and supported by the full committee, may provide a key vehicle for attaining stabilization of this risk growth.

During our review, it was frequently noted that the current risk program includes items that are virtually certain to occur. While the overall cost impact may be appropriately captured due to analysis of these risks at a 90% or similar probability level, project planning has not yet incorporated these elements into the project baseline or working plans. This leads to discussion of the reality of needing these funds on the project, the uncertainty of when such costs will be incurred, and numerous other problems that lead to lower confidence in the current project approach and plans. Some examples include the need for system engineers, the staffing of E&NS functions, and other similar issues. While we recognize there may be some contractual issues involved for some of these elements, it is essential that the project move forward to plan and staff according to its needs. If a need is evident, real, and known to be needed, it should be included in the project baseline plan and acted upon accordingly.

As ORP continues to develop the One System (2020 Vision) approach of integrating the Tank Farm program with the WTP, a cost benefit analysis should be done to validate that this is the preferred solution. The "One System" approach is the keystone to the early operation of the LAW facility and early glass production. However, it is dependent on various Tank Farm

projects that are estimated at approximately $300M to $400M, including microfiltration, small column ion exchange (SCIX), and hose in hose transfer lines (HIHTL). Although the Committee supports the "One System" approach, the near term costs, funding requirements, and the overall benefits need to be analyzed and presented to and approved by EM at DOE Headquarters.

Should Congressional Appropriations for FY12 and FY13 be below the current contract funding profile, cost increases and schedule delays would be realized for the Project in addition to the Committee's forecasted overrun discussed previously.

5.3 Recommendations

Recommendation 1 – DOE-ORP initiate a cost benefit analysis of the "One System" approach by November 1, 2011..

Recommendation 2 – DOE-ORP finalize the phased CD-4 Baseline Change Proposal and submit it to EM-HQ for review and an Acquisition Executive decision.

Recommendation 3 – BNI and DOE-WTP complete forecast update 5 (FU-5) by January 2012 and include identified risks that may result from the current unresolved technical issues, incorporate changes in the technical approach, reflect realistic expectations of productivity, and incorporate all very high probability threats.

Recommendation 4 – The FPD EAC analysis be available to the subcommittee at the next CPR review.

6. MANAGEMENT

The Management Subcommittee was charged with responding to the following questions:

- Is the project being properly managed for its successful execution?

Response: Yes. Both DOE and BNI have highly qualified management and leadership teams. This is absolutely necessary recognizing the size and complexity of the WTP Project and the very difficult external interfaces.

- Are integrated capital asset, operations, and acquisition plans in place to ensure mission objectives are met in construction and operations decisions?

Response: Not yet. Very active planning activities are underway with full participation and support of the WTP Project and the Tank Farms Program. In fact, WTP plans are nearly complete. When complete, these planning activities should identify an integrated management and technical execution approach for waste feed delivery and WTP startup.

In response to the overall question to the Committee: With the exception of the EM HQ portfolio manager issue, yes, they have properly responded to previous recommendations.

6.1 Findings

The DOE and BNI leadership teams are highly qualified and are working well together. There has been stability at the top level in both DOE and BNI organizations. A "Zippering Plan" is in place, "to clearly identify counterparts and communication channels among WTP project interfaces."

While all elements of DOE seem to recognize the importance of the River Protection mission, EM HQ does not have a program portfolio manager in place with responsibility to integrate and prioritize WTP and TF efforts together with the corresponding capital and operations budget decisions in an optimal fashion. This manager would also represent the mission to the stakeholders in Washington DC; namely, the rest of EM, DOE, OMB, and the Congress.

A complete and disciplined set of project management processes are in place and generally being followed, with EAC development being an exception as indicated below.

WTP presented strategies for a "One System" approach to WTP and Tank Farms integration, commissioning, startup, licensing and other activities necessary to achieve WTP Initial Plant Operations to meet the 2022 Consent Decree milestone. In addition, ideas are being developed that have potential for cost and/or schedule improvements.

6.2 Comments

Both DOE and BNI have established strong leadership and management teams for WTP. It is imperative that continuity in the management teams be maintained at both the senior and mid-management levels.

It is noted that ORP has new leadership and a constructive relationship with the WTP Project has been established. With this improved on-site coordination, the need for strong EM HQ integration is even more apparent.

Consistent with previous CPR's, the Management Subcommittee continues to endorse the revised CD-4 strategy for implementing the phased commissioning. We also support the change to move hot commissioning from project scope into the operations program. The revised approach is consistent with other DOE nuclear/chemical projects and is a more realistic point of demarcation between construction-like activities and operations-like activities. While a strong, comprehensive effort has been initiated to integrate the WTP and Tank Farm activities, and is fully supported by WTP and TF leadership, it is not clear whether funding will support these plans. As an example, the FY 2012 Budget Request was insufficient to meet the Tank Farms requirements for implementing the One System 2020 Vision approach.

As discussed in the technical section of this report, much of the design and planning for WTP is dominated by a small fraction of the wastes in the tanks. There may be options to optimize the overall startup and operational strategy for WTP by dealing with these "problematic" wastes in a tailored manner.

The Management Subcommittee addressed contract management aspects of the WTP and concluded that ORP has allocated sufficient resources to administer the BNI contract. Contract actions are being addressed in a prompt manner.

A plan for aligning the BNI and WRPS contracts to be consistent with the "One System" concept was presented. This would provide the option of extending both contracts through the initial operations period. This approach has merit and should be developed. The project team should use this opportunity to strengthen contract incentives as noted in previous CPR reports.

It is recognized that as WTP moves forward, the Management Reserve account is likely to be exhausted. In that event, it may be necessary to make non-fee bearing increases to the BNI

Contract Budget Base with accompanying decreases in the DOE held contingency. Discussions with the ORP Contracting Officer confirmed that this type of change could be handled in a straightforward manner.

As is evident from the analysis and conclusions of the Cost/Schedule/Risk subcommittee, the management process for developing a realistic Estimate at Completion (EAC) for the entire WTP project needs improvement.

6.3 Recommendations

Recommendation 1 – EM HQ needs to establish by November 2011 a strong portfolio program manager with authority and accountability for both WTP and TF, consistent with the "One System" concept. This is similar to recommendations from previous CPRs.

Recommendation 2 – ORP should implement a tactical approach to operations and modify the System Plan and associated feed vectors to address near term waste treatment processing constraints and opportunities – by October 2011.

Recommendation 3 – ORP should quickly advance the licensing strategy for the problematic wastes that should be restricted from near-term transfers and processing – by October 2011.

Recommendation 4 – BNI should provide its plan to DOE by November 2011 that ensures continuity of senior and mid-level BNI managers. DOE should develop a plan to retain its key personnel by January 2011.

APPENDIX A

CHARGE MEMORANDUM

The Deputy Secretary of Energy
Washington, DC 20585

July 29, 2011

MEMORANDUM FOR ROBERT RAINES
DIRECTOR, PROJECT MANAGEMENT SYSTEMS AND ASSESSMENTS
OFFICE OF ENGINEERING AND CONSTRUCTION MANAGEMENT

FROM: DANIEL B. PONEMAN

SUBJECT: Construction Project Review of the Waste Treatment and Immobilization Project at the Office of River Protection at Hanford

I request that you organize and conduct a Construction Project Review (CPR) of the Waste Treatment and Immobilization Project (WTP) at the Hanford Site in Richland, Washington, from August 22-25, 2011. The purpose of this review is to assess the project's cost, schedule, and technical progress against the approved Performance Baseline.

In April 2003, the project achieved Critical Decision (CD)-3, *Approve Start of Construction*. Currently, CD-4, *Approve Project Completion*, is planned for November 2019, with a total project cost of $12.26 billion.

The November 2010 CPR highlighted significant focus areas in its recommendations. The August 2011 review should report on the Department's progress against those prior recommendations as well as answer the following questions:

Technical: Is the project team making timely, substantive progress on resolving the outstanding technical issues to complete the design and focus on construction and start up activities? Are WTP technical issues being resolved in coordination with tank farm activities to allow for an integrated tank waste system approach to processing waste? Are there any unresolved issues associated with technology, design, or nuclear safety?

Cost, Schedule, and Risks: Are costs and schedule estimates-to-complete, including the risks and contingency, reasonable and achievable? Are construction activities proceeding as scheduled, with focused constructability reviews to continuously improve the overall effectiveness and schedule?

Management, Acquisition, and Prior Reviews: Is the project being properly managed for its successful execution? Are integrated capital asset, operations, and acquisition plans in place to ensure mission objectives are met in construction and operations decisions?

Environment, Safety, Health (ES&H), and Quality Assurance: Are ES&H and Quality Assurance programs, controls, and processes sufficiently mature for the project's current stage of development?

Commissioning: Is the startup and commissioning process reasonable and executable? Are adequate resources budgeted for this effort?

Thank you for serving as the Review Committee Chair for this CPR. Mr. Dale Knutson will serve as the point of contact for this review. I look forward to receiving your committee's report within 60 days of the review's conclusion.

cc: R. Lagdon, S-3
D. Huizenga, EM-1 (Acting)
D. Chung, EM-2
C. Anderson, EM-3
T. Johnson, EM-3.1
L. Ely, EM-10 (Acting)
J. Hutton, EM-20 (Acting)
Y. Collazo, EM-30
J. Surash, EM-80
P. Bosco, MA-50
M. Samuelson, ORP
D. Knutson, ORP
D. Noyes, ORP
T. Brown, ORP
F. Russo, BNI
C. Albert, BNI
D. Pethick, URS

APPENDIX B

COMMITTEE ROSTER

Committee Roster

Bob Raines, NNSA, Chairman

Lowell Ely, EM, Vice-Chairman

Technical

David Kosson**	Vanderbilt Univ.
Steve Agnew	Columbia Energy
Kevin Brown	Vanderbilt Univ.
Barry Naft	Environmental Int'l.
Kent Fortenberry	URS
Ken Picha	EM-21

Startup & Commissioning

Chip Lagdon**	S-2
Jim Hutton	EM-20
Bob Warther	B&W Y-12

ESH&Q

Michael Mikolanis**	SRS
Nicole Brooks	DOE-ID
Jim Davis	EM-23
Greg Rowland	ORNL
Ray Wood	Trinity Eng.

Cost, Schedule, Risk

Kurt Fisher**	SC-28
Chris Gruber	Consultant
Jim LaClair	Shaw/Areva
Lenny Mucciaro	EM-62
John Post	LLNL
Al Simonti	Shaw/Areva

Management

Les Price**	Consultant
Jeff Burgan	MA-621
Scott Cannon	SRSO
Tony Polk	SRS
Chuck Swain	Parsons

Observers

Dale Knutson DOE-WTP, Robert Diebold Consultant, Brian Kong OECM, Mark Whitson OECM, Scott Samuelson DOE ORP Mgr., Rick Khan S-2, Dan Lehman* SC-28, Keith Klein Consultant, Jay Glascock OECM

*Special Advisor to the Chair
**Subcommittee Chair

APPENDIX C

REVIEW AGENDA

AGENDA

Department of Energy Construction Project Review
Waste Treatment Plant (WTP) Project
August 22-25, 2011

Monday, August 22, 2011
Project Office North Annex (PONA) (2505 Garlick Boulevard) Room 1407

7:15 a.m.	Badging [PONA Lobby]
	[CPR Review Team Participants Only]
7:30 a.m.	CPR Team Executive Session ..... Bob Raines
	[WTP Participants to Join]
7:45 a.m.	DOE Project Overview ..... Dale Knutson
8:00 a.m.	Safety Topic and Logistics ..... Rick Kacich
8:10 a.m.	Construction Project Review Team Lead Introduction ..... Bob Raines
8:25 a.m.	Overview and Assessment of Project ..... Frank Russo
	- Safety Performance
	- Overall Project Status
	- What's Changed since November 2010
	- Large-Scale Integrated Testing
	- Technical Issues
	- Plan for Forecast Update 5 and 6
	- Nuclear Safety Culture (Gap Analysis, HSS Report, Pillsbury Report)
	- Headroom Analysis; Summary MR & Contingency
	- 2020 Vision One System Overview
9:10 a.m.	Break
9:25 a.m.	Progress on Technical Issues ..... Tom Patterson
9:55 a.m.	Safety Design Strategy ..... Donna Busche
10:05 a.m.	TPCC Analysis and Update ..... Mike Blake
10:35 a.m.	Project and Facility Status
	- Overview ..... Rick Bradford
	- LBL ..... Bill Clements
	- HLW ..... Joe St. Julian
	- PT ..... Ray Patterson
11:30 a.m.	Safety, Quality, and Commissioning ..... Bill Gay
11:50 a.m.	NSQC ..... Mike Coyle
12:00 p.m.	Group Photo [PONA Lobby]
12:15 p.m.	Working Lunch
12:45 p.m.	Depart PONA for Site Visit ..... Ty Troutman
1:15 p.m.	Arrive at Visitor's Center
3:45 p.m.	Depart WTP Site for PONA
5:00 p.m.	CPR Team Executive Session [PONA 1407] ..... Bob Raines
6:15 p.m.	CPR Team Dinner [Marriott]

Tuesday, August 23, 2011

8:00 a.m.	2020 Vision One System [PONA 1407] ..... Ben Harp
9:00 a.m.	Pulse Jet Mixing and LSIT [PONA 1407] ..... Garth Duncan/Bob French
8:00 a.m.	Subcommittee Breakout Sessions (see individual agendas).....
5:00 p.m.	CPR Team Executive Session [PONA 1407] ..... CPR Review Team

Wednesday, August 24, 2011

8:00 a.m. Subcommittee Breakout Sessions (see individual agendas).....

5:00 p.m. CPR Team Executive Session [PONA 1407] .....CPR Review Team

Thursday, August 25, 2011

8:00 a.m. DOE Executive Session .....Bob Raines

11:00 a.m. Outbrief and Closeout [PONA 1407].....Bob Raines
(Video conference to DOE HQ planned for the CPR outbrief)

APPENDIX D

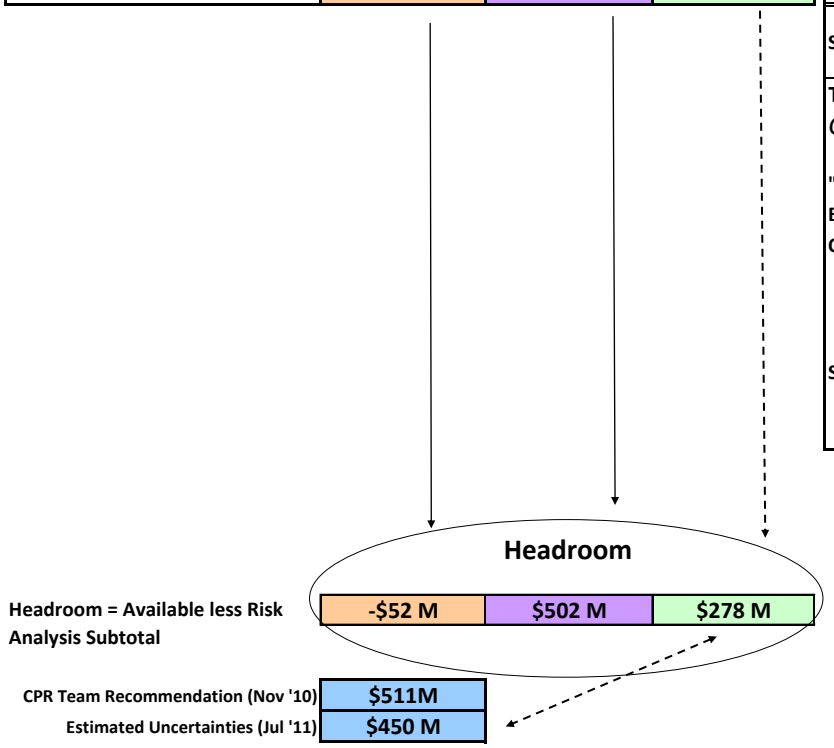
COST TABLE

WTP TPC Status

CPR where Reviewed	CPR-Nov 10	CPR-Mar 11	CPR-Aug 11
Data point	Oct 2010 FU4	Feb 2011	Jul 2011
TPC	$12,263 M	$12,263 M	$12,263 M
DOE Cost	$117 M	$117 M	$125 M
Subtotal	$12,146 M	$12,146 M	$12,138 M
Fee	$615 M	$615 M	$610 M
Adjustment to Fee from CD-4 Implementation			-$81 M
Subtotal	$11,531 M	$11,531 M	$11,609 M
EAC	$10,907 M	$10,647 M	$10,733 M
Available MR/Contingency	**$624 M**	**$884 M**	**$876 M**

Risk Analysis Results

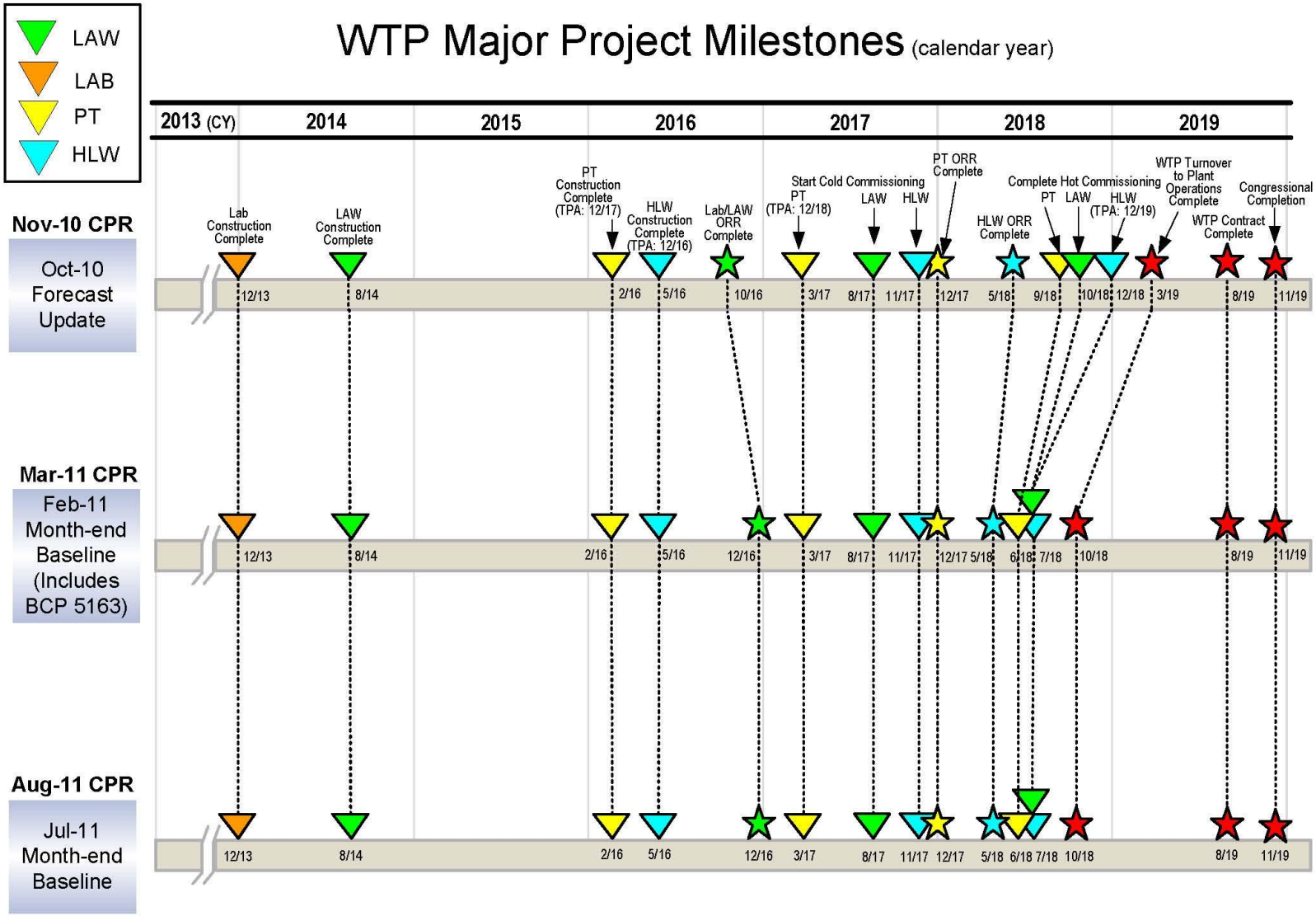
CPR where Reviewed	CPR-Nov 10	CPR-Mar 11	CPR-Aug 11
Data point	Oct 2010 FU4	Feb 2011	Jul 2011
Cost			
EPCC 80%	$547 M	$703 M	$692 M
less EPCC Threat Aggregate Adj.	-$55 M	-$75 M	-$75 M
plus EPCC Opportunity Aggregate Adj.			$9 M
S/T EPCC	$492 M	$628 M	$626 M
DOE 80%	$184 M	$254 M	-$17 M
plus DOE Threat Aggregate Adj.			$4 M
plus DOE Opportunity Aggregate Adj.			-$15 M
S/T DOE	$184 M	$254 M	-$28 M
Total WTP Risk Assessment @ 80% Confidence level	$676 M	$882 M	$598 M
"One System" Risk Adjustment		-$282 M	
Early Start Schedule Challenge		-$108 M	
Other Opportunities/Challenges		-$110 M	
Subtotal Opportunities/Challenges	$0 M	-$500 M	$0 M
Subtotal	$676 M	$382 M	$598 M



APPENDIX E

SCHEDULE

WTP Milestone Schedule



APPENDIX F

FUNDING

LI	August 2011 Funding Model (Early)	To Date	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	Total
	Costs												
1	EPCC Project Costs	$5,910	$742	$821	$870	$707	$628	$477	$347	$205	$25	$0	**$10,733**
2	DOE Project Costs	$117	$5	$3	$0	$0	$0	$0	$0	$0	$0	$0	**$125**
3	**Subtotal Costs**	**$6,027**	**$747**	**$824**	**$870**	**$707**	**$628**	**$477**	**$347**	**$205**	**$25**	**$0**	**$10,858**
	Fee												
4	Fee *	$151	$31	$56	$29	$40	$31	$24	$50	$80	$39	$0	**$531**
	Risk												
5	EPCC Risk (Threats and Opp. with Aggregate Adj.)		$4	$115	$163	$134	$81	$36	$24	$20	$49	$0	**$626**
6	DOE Risk (Threats and Opp. With Aggregate Adj.)		$14	$52	$44	$40	$57	$53	($82)	($157)	($49)	$0	**($28)**
7	**Subtotal Risk**		**$18**	**$167**	**$207**	**$174**	**$138**	**$89**	**($58)**	**($137)**	**($0)**	**$0**	**$598**
8	**Total Project FY Costs**	**$6,179**	**$796**	**$1,048**	**$1,106**	**$922**	**$797**	**$590**	**$339**	**$148**	**$64**	**$0**	**$11,988**
	Funding												
9	**Annual Funding**	**$6,395**	**$740**	**$840**	**$970**	**$890**	**$790**	**$600**	**$380**	**$355**	**$240**	**$63**	**$12,263**
		To Date	**FY11**	**FY12**	**FY13**	**FY14**	**FY15**	**FY16**	**FY17**	**FY18**	**FY19**	**FY20**	**Total**
10	To Date Funds	$6,395	$7,135	$7,975	$8,945	$9,835	$10,625	$11,225	$11,605	$11,960	$12,200	$12,263	
11	To Date Costs	$6,179	$6,975	$8,022	$9,128	$10,050	$10,847	$11,437	$11,776	$11,924	$11,988	$11,988	
12	Uncosted Commitments (Setasides)		$88	$81	$84	$72	$57	$39	$29	$17	$0	$0	
13	Funds Over / Under (Cumulative)		$72	($129)	($268)	($288)	($280)	($251)	($200)	$19	$212	$276	

* Fee Includes ($81M) reduction for Fee associated with Hot Commissioning.